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BIRD-BANDING

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CONTENTS

FURTHER CONTRIBUTIONS TO THE KNOWLEDGE OF THE CAPE COD STURNINÆ. By *O. L. Austin, Jr.* 4 Figures 123

STATE DISTRIBUTION OF RETURNS FROM BANDED DUCKS. First Paper, Alberta. By *Frederick C. Lincoln.* 1 Map. 140

THE STATUS OF CAPE COD TERNS IN 1932. By *Oliver L. Austin*, M.D. 143

A STUDY OF TWO NESTS OF THE BLACK-THROATED GREEN WARBLER. Part II: Chronicle of the August Nest. By *Margaret M. Nice* and *L. B. Nice.* 1 Chart. 157

GENERAL NOTES.—Strange Disappearance of Penikese Island Terns, 173; Early Bird-Banding in Europe, 174; Nine More Snow Bunting Returns-W, 175; Some Rare or Unusual Birds Banded on Cape Cod, 176; A Wood Thrush Recovery, 177; Two Pairs of Tree Swallows Mated During Two Seasons, 177; The Occurrence of Botulism in a Herring Gull, 178; Some White-Throated and Field Sparrow Returns, 178; A Cowbird Attempts to Parasitize Barn Swallows, 178; Queer Albinism in a Purple Grackle, 179; Juvenile Eastern Song Sparrow Returns to Birthplace, 179.

RECENT LITERATURE.—*Der Vogelzug*, Vol. 3, No. 3, July 1932, 180; *The Birds of Minnesota*, by Thomas S. Roberts, M.D., University of Minnesota Press, Minneapolis, Minn., 1932, 180; *Portraits of New England Birds*. Published by the Commonwealth of Massachusetts, 1932, 181.

BIRD-BANDING

A JOURNAL OF ORNITHOLOGICAL INVESTIGATION

VOL. III OCTOBER, 1932 NO. 4

FURTHER CONTRIBUTIONS TO THE KNOWLEDGE OF THE CAPE COD STERNINÆ[1]

By O. L. AUSTIN, JR.

THE nesting of the Terns on Tern Island at Chatham, Massachusetts, has always been remarkable for its earliness. Banders have been amazed to find young birds almost ready to fly early in July, when on all the other near-by rookeries the eggs were still being incubated. Indeed, the Terns lay their eggs here long before they have started courtship proceedings on Muskeget and Penikese, and even prior to the normal season at Cobb Island, Virginia, far to the southward. This phenomenon has yet to be explained satisfactorily. It must be a reaction to local environmental conditions, but the factors responsible for the variance from the normal are not yet evident.

The spring just past was comparatively a late one. The Terns arrived off the Chatham coast, according to the fishermen who make daily trips to the outside cod grounds, on April 20th, and remained off shore as the flocks increased in size, until suddenly, on April 26th, they "came to land" at Tern Island. They flew around the island and rested on the neighboring beaches and sand-bars for two days, and then returned to fish on the outside shoals for another week. They returned to commence their nesting activities on May 3d, but only in about one third the numbers usually present in the rookery at the height of the season.

THE EXPERIMENT ON THE NESTING AT TERN ISLAND

The past four years have witnessed a steady increase in the amount of ground covered by beach-grass on Tern Island and a steady decrease in the patches of open sand. Not only has the grass encroached on the open areas, it has also increased remarkably in height and thickness, no doubt encouraged by the heavy fertilization it receives each summer from guano.

[1]Contribution No. 11 from the Austin Ornithological Research Station.

dead fish, and dead birds. In 1928 there were about five acres in the center of the rookery almost free of vegetation. Today this is reduced to not more than a single acre. All over the island the grass is higher and thicker than ever before. I commented in a previous paper[2] on the fact that the Roseate Terns limit their nesting on Tern Island to the heavily grassed areas, while most of the Common Terns nest either in the open, or else in the sparse grass. The Common Tern chicks hatched in nests in open areas always take cover in the grass a few days after emerging from the shell. A certain amount of vegetation is necessary to the welfare of the terns, to provide the young birds shelter from the hot rays of the sun. But too much grass may be ecologically unsuitable for both species, for not only does it make nest-building difficult, but it affords cover for predatory animals such as rats.

Primarily to determine the relationship between the vegetation and the nesting of the Terns, three sample quadrats were laid out in the rookery on April 22d, before the birds first came to land. Three squares, ten meters on each side, were marked out by pegging down inch-wide strips of canvas on the ground with long wire staples. The first was placed in the heavily grassed section of the rookery, where, when the beach-grass was slightly sparser, the Roseate Terns used to breed so successfully. The next was staked out in the center of the last remaining sandy opening. The third was laid in an area recently covered with a few sparse patches of beach-grass.

A fourth quadrat was also laid out, in territory ecologically similar to the last, partly open sand and partly sparsely grassed, which was used primarily for experimental work and close observation on the individual nesting territorial relationships. The birds in this quadrat were more or less continually disturbed by our activities, with the result that fewer pairs nested in it than on the other ecologically similar plot a hundred yards away.

As the Terns commenced selecting nesting sites, the quadrats were mapped, and from the time the first egg was laid on May 23d, the quadrat nests were checked at regular intervals until the final disappearance of the last egg and chick on July 10th brought the breeding season on Tern Island to a close.

The first, or normal laying of eggs commenced on May 23d, and was completed by May 31st. At this time the totals were

[2] *Bull. Northeastern Bird-Banding Assoc.*, Vol. V, No. 4, pp. 133.

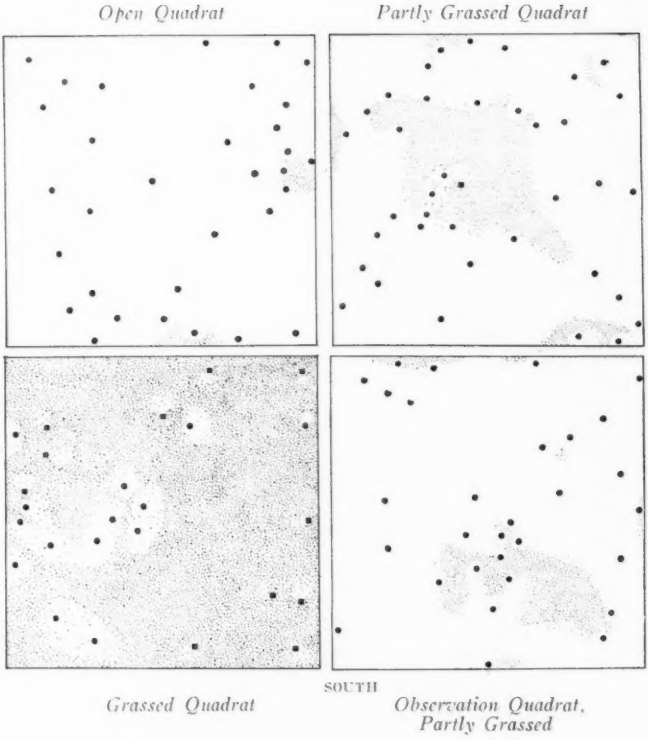

FIGURE 1. SHOWING THE FOUR TEN-METER QUADRATS ON TERN ISLAND.

LEGEND { Nests of Common Terns Represented by Round Dots.
Nests of Roseate Terns Represented by Square Dots.
Stippled Areas Represent Beach Grass.

Grassed quadrat	25	nests	47	eggs	average	1.9	eggs	per	nest
Open quadrat	32	"	83	"	"	2.6	"	"	"
Partly grassed quadrat	38	"	106	"	"	2.7	"	"	"
Partly grassed observation quadrat	30	"	75	"	"	2.5	"	"	"

In the heart of the largest patch of grass in the center of the partly grassed plot was one nest of a Roseate Tern. In the grassed quadrat fourteen of the nests were of Common Terns, eleven of Roseates. The open plot and the observation plot contained only Common Terns.

It is obvious that the heavily grassed condition is not preferred by the Common Terns, though it is evidently more or less essential to the Roseates (on Tern Island at least; on other rookeries, notably Muskeget, the Roseates as well as the Commons are known to nest in the open). The absolutely grassless condition, while infinitely preferable to the heavy grass, is in turn excelled by the partly grassed sites.

Broken and deserted eggs began to appear on the quadrats shortly after the laying commenced, but not in sufficient numbers at first to cause any alarm. By June 2d, it became apparent that the breakage was abnormal, and from then on the eggs continued mysteriously to disappear. As they disappeared, new nests and eggs appeared, evidently second layings, and they continued to appear throughout June and the first part of July in all except the heavily grassed quadrat, where no second nesting was attempted. Counting all the eggs laid in the quadrats from May 23d until July 10th, the totals were:

Grassed quadrat	25	nests	47 eggs
Open quadrat	50	"	130 "
Partly grassed quadrat	67	"	165 "
Partly grassed (observation) quadrat	71	"	161 "

The only eggs to hatch were those of the first laying. Not a single egg hatched of the many that were laid in June and early July. The percentage of eggs to hatch in each plot varied in inverse proportion to the amount of grass present, thus:

Grassed quadrat	47	eggs	laid	15	hatched	32%
Partly grassed quadrat	106	"	"	55	"	52%
Partly grassed (observation) quadrat	75	"	"	57	"	76%
Open quadrat	83	"	"	75	"	90%

This ratio indicates that the grass is a decidedly detrimental factor. The difference in the percentages of hatch in the two partly grassed quadrats may be partly explained by the fact that the destructive agents had less opportunity to act on the observation plot, because it was farther from the heavy grass and slightly more open.

The duration of the period of incubation may be estimated most conveniently and most accurately as extending from the date of laying of the last egg in each nest to the date of hatching of the last young in that nest. In the grassed plot, the amount of incubation received by the eggs in each of the eight nests in which chicks were hatched was as follows:

Days	*No. of Nests*	
21	1	
22	1	
23	3	
24	2	
25	1	Average 23.1 days per nest

In the open plot the thirty-one nests in which chicks were hatched were incubated:

Days	*No. of Nests*	
21	1	
22	1	
23	0	
24	3	
25	12	
26	9	
27	3	
28	1	
29	0	
30	1	Average 25.4 days per nest

In the partly grassed observation quadrat the twenty-seven nests bringing forth chicks hatched in the following times:

Days	*No. of Nests*	
24	3	
25	5	
26	11	
27	5	
28	2	
29	0	
30	1	Average 26 days per nest

The other partly grassed plot had chicks hatched in twenty-nine nests as follows:

Days	*No. of Nests*	
23	2	
24	4	
25	6	
26	12	
27	3	
28	2	Average 26.2 days per nest

Taking into consideration the ninety-five nests in which chicks were hatched (see graph), we find the period to vary from twenty-one to thirty days, with an average of 25.7 days. It is noticeable that the period averages markedly shorter in the

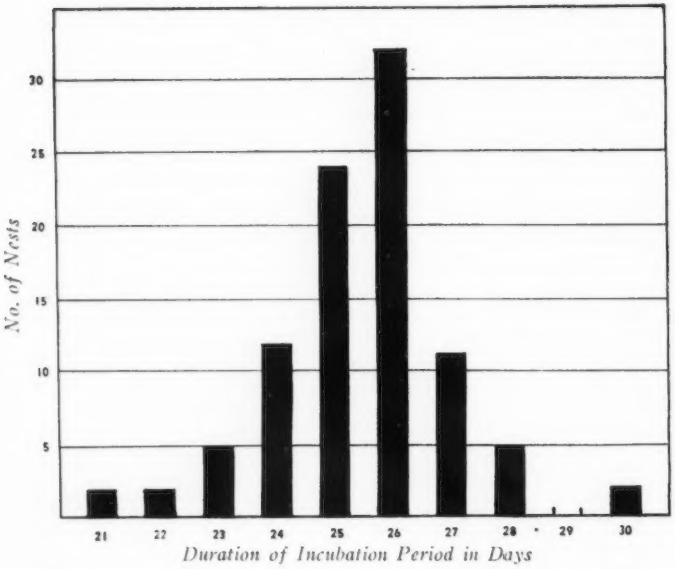

FIGURE 2. HISTOGRAM SHOWING DURATION OF INCUBATION PERIOD IN NINETY-FIVE NESTS.

heavily grassed quadrat than in the other three. This is doubtless because the birds were disturbed there by our activities less than in the more open plots, where more trapping was done and the birds were considerably wilder. Incidentally, these figures likewise refute the hypothesis occasionally advanced that the eggs of Terns may be incubated in part by the sun. The eggs in the open quadrat received much more heat from the sun's rays than those in the grassed plot.

The first young Terns hatched out on June 12th. Between then and June 30th there were banded on the rookery, including the 202 quadrat chicks, 1716 young Common Terns and 38 young Roseate Terns. By June 18th it was obvious that something was destroying the chicks, for the banded birds began to disappear as mysteriously as had the eggs. Very few dead birds were found, and only unbanded, newly hatched chicks were encountered. No young were found more than four days after banding. The grass was combed for them unsuccessfully. One quadrat was surrounded with a fence of

inch-mesh chicken-wire eighteen inches high to keep the chicks from straying, but they disappeared from this as rapidly and as mysteriously as from the rest of the rookery.

House rats were undoubtedly to blame for a large percentage of the damage, but it is probable that they were not entirely responsible. In April a careful combing of the island revealed no signs of rats whatsoever. The first evidences of rat work were found on May 14th,—an adult Tern freshly killed and partly eaten. The following day the whole island was poisoned thoroughly with red squill, but no dead rats were found afterwards. A second broadcasting of poison baits on June 6th had no results. There was such an abundance of food available in the eggs that almost no baits were taken. Then with the burning of the Chatham town garbage dump a half-mile away during the second week in June for the first time in years, the influx of rats was marked. The thickness of the grass gave them such good cover that it was impossible to combat them in any way. On July 6th, when during previous years the island was always literally alive with chicks in every stage of development, and was enveloped in a white cloud of busy adults, this season it was, well, just a grass-covered sandy island. We found a mere handful of eggs, no chicks whatsoever, and we counted but 150 wary adults present! By June 10th these last hardy remnants had gone, and, except for the rustling of the rats in their runways under the grass, the island was quiet.

Behavior During Courtship and Incubation

Although the breeding season for the Terns on Tern Island was unsuccessful, it proceeded more or less normally from the start of courtship through the incubation period. Ten feet from the partly grassed quadrat which was used for territorial studies, an observation blind was built where it would not interfere with the natural course of events on the plot, but would still provide a good vantage point for close observation.

The birds came to land on May 3d. I do not believe that many, if any, were paired off at this time, for the ensuing week was taken up with the selection of mates. There are many angles of the sexual activity which are still hidden from us, and to investigate them is not easy. In the first place there is so much taking place at once that it is difficult to focus attention on the actions of a single pair. Secondly, the lack of sexual dimorphism makes it necessary to judge sexes by actions alone, and inasmuch as the sexes in the terns are very

balanced psychologically, and each shares the work attendant to reproduction, the only infallible clue we have to the sexes of the birds is the act of copulation, during which the male is always dorsad to the female. The copulation is not begun until two weeks after the birds arrive on the nesting grounds. Nevertheless, our knowledge of the habits of other species gives us a few clues as to the probable sexual identity of the individual terns.

It is notable that the adults commence to carry fish to the rookery when they first arrive, and that they continue to do so regularly until after the young are able to fly. Theoretically, until the young are hatched only the male brings in fish, but it has yet to be proved that the female does not. Although food is actually necessary on the rookery only when there are hungry young to be fed, the act of bringing it in is intimately bound up with the courtship and the incubation. It is undoubtedly a secondary sexual impulse most probably impelled and controlled by the gonad hormones.

When the birds arrive, the first duties are the selection of mates, and the choosing of territories. The two are evidently accomplished at the same time, the former very definitely, the latter but vaguely. While the two acts are intimately bound together, it is difficult to say which sex, if either, is the dominant one. There is no selection of a territory by the male, to be occupied by the female later, as occurs in so many Passerines. If one holds the bringing-in of fish to be limited to the males, selection of mates is certainly done as much by one sex as another. Both sexes arrive together, and one observes two females dancing around one male as frequently as two males courting one female. At first the courtship dance is almost as frequently a trio as it is a duo, but it soon narrows to a single pair. The dance is usually performed while one of the pair (presumably the male) holds a fish in its bill, but frequently occurs without it. While uttering a continuous, throaty chuckle, both sexes circle about on stiff legs, head cocked slightly to one side, the feathers of the high-arched neck ruffed into a graceful curve, wings held away from the body at a stiff angle with "elbows akimbo" and ends dragging in the sand, the tail pointing skyward. After about thirty seconds of the dance, in which the female may make several unsuccessful attempts to take the fish, the male gives it to her. They chuckle contentedly, relax to a normal posture, and one, or both, usually flies away.

It is difficult at this early stage to determine the extent to which territories are selected, for it is impossible to trap and mark the birds individually until nesting activities are begun.

However, there were on the quadrat several birds already banded which were observed to alight in approximately the same place again and again. In general each of these tended to stay in a somewhat localized area, roughly twenty feet in diameter. There was very little actual bickering and fighting, and nothing occurred that could be interpreted as the driving-away of intruders.

The colony increased in size daily as more and more birds arrived. On May 9th, six days after the first ones came to land, a new activity commenced. The birds started to hollow out their nests. That this act is primarily a secondary sexual reaction, and is not done purposefully with the future need for a nest in view is quite evident. The digging procedure is intimately connected with the other courtship antics. Many nests are started, hollowed out completely, and abandoned before the eggs are laid. Both sexes share the digging, which starts at a low intensity, and increases in frequency and vigor as the season progresses and the days of egg-laying approach.

A slight, wind-blown depression may be selected as the nucleus of the nest, and not infrequently a footprint in the sand is utilized. Otherwise the bird makes its own depression by squatting on the ground and rotating its body, scooping out sand with its feet. The hole once started, the bird deepens and shapes it. Resting its breast in the middle of the hole, it pushes sand out behind by paddling its feet alternately. Each pair starts several holes, sometimes as many as six, both birds often digging in different places at once. The digging act is frequently prefaced by a short strutting and feeding. Not infrequently one bird of a pair leads the other to a hole, which both inspect. One of them finally enters it to shape and dig. After a moment or so of work, it may rise, walk to another depression, and continue digging, while its mate enters and commences to dig in the hole just vacated.

At this stage it is possible to catch the adults by setting drop traps over the partly finished holes. As each bird was captured, it was marked by a combination of colored celluloid bands, which made individual identification not only positive, but comparatively easy and simple. It was then observed that while each pair of birds had established its nesting territory in a general way, territorial rights were not yet strictly enforced. Each pair of birds had its own series of nesting holes, but neighboring pairs frequently dug in the same depressions, and individuals were often observed to alight fifty feet from the holes they were digging, and to walk unmolested past other digging and

courting birds on their way to what eventually they made their "homes."

There is a definite relationship between temperature and sexual activity in the Terns. On cold, cloudy or drizzly days, the birds stand about passively, and the courtship is limited to a little desultory strutting and feeding. Their territorial sense is dulled, and they do not attempt to repel intruders, either human or avian. But when the sun shines hotly and the winds die down, they react violently. They court feverishly, dig happily at their nests, squabble and bicker among themselves about boundary rights—in increasing vigor as the season progresses—and dart ferociously at any human being who ventures near their nests.

After about a week of intense courtship, the male is observed to alight on the back of the female and stand there quietly for a short time. This stimulating procedure occurred commonly all over the quadrat for the first time on May 16th, but not once that day was a female observed to become receptive so that a union could be attempted. Usually the male stood passively for from a few seconds to a full minute, and then flew away. In one case a pair danced about each other, the male with a sand-eel in his bill. After thirty seconds of strutting, the male hopped upon the female's back. Both stood passively for about thirty seconds more, and then the female reached backward with her beak and took the minnow from her mate. Both immediately flew away. When they returned ten minutes later, they turned their attentions to scooping out nest-holes.

On May 17th this pre-copulatory activity increased, and culminated in some cases in successful mating. While the act of copulation is evidently attempted unsuccessfully many times before the union is effected, I did not observe one pair complete the act more than once, nor attempt it again after once completing it.

During the next five days these activities waxed and waned with the varying weather conditions. On May 23d the first eggs were laid. In the observation quadrat five eggs were deposited, one in each of five nests. By the 24th there were twenty-four eggs present in twenty nests, on the 25th thirty-nine eggs in twenty-five nests. The increase was regular until the 31st, when seventy-five eggs had been deposited in thirty nests.

The normal clutch in the Common Tern is three eggs, though frequently but two, and in two cases four, were laid. The rate of deposition varies exceedingly. It is rare that one egg is laid each day until the clutch is completed; usually two, and in

five instances four days elapsed between layings in each nest. Generally the parents do not incubate until the clutch is completed, unless the sun is exceptionally hot or there is danger of the eggs cooking if left uncovered.

Immediately after the laying of the eggs the behavior of the adults changes. There is no more strutting, but one (the male?) continues to feed the other on the rookery. Both sexes share the incubation duties, though to what extent each broods the eggs is still unknown. There seem to be no set times of the day for each bird, but rather a happy, careless spirit of haphazard coöperation. This was brought out forcibly by the trapping. One bird of each pair (presumably the female) is always much more eager to incubate, and overcomes its fear of the traps more quickly. The mate is always more difficult to catch, and presumably incubates only when the other is not around. Numerous times I have set a trap, to have the first owner of the nest to return show fear of it, walk round and round it, hesitatingly poke its head under the wire, and withdraw in fright. But when its mate returned a few minutes later, the newcomer walked right onto the eggs with no fear at all. Time and again the changing of the incubators is observed. The incubating bird is joined by its mate, which stands by quietly until the eggs are vacated for it, upon which it takes up its share of the work. I once saw a bird entreat its mate to incubate. Its actions, as it arose from the nest, waddled to its loafing partner five feet away, and nudged it up to the eggs, said plainer than words: "I've been here long enough and I'm cramped and hungry. Get on there and get to work. It's your turn."

As incubation progresses, territorial relationships become more and more pronounced. Birds alight closer to their nests, or on obviously neutral ground, and brooding individuals leave their nests to drive off intruders. The importance of sex in this regard is again apparent, for the hotter the day, the more finicky are the birds about trespassers, and on cold days, they seemingly do not care who goes where.

Two nests in the observation quadrat were but eighteen inches apart; these were the closest together of any I observed. I had caught and marked both adults on the first nest, and one on the other. A trap was set on the second nest to catch the non-banded bird. One of the first pair returned at once to incubate a foot away from one edge of the trap. The unbanded bird evinced fear of the wire cage. Its banded mate was absent. After circling the trap several times, starting to go under and backing hurriedly away, it suddenly attacked the

incubating bird next to it! Both birds flew up, the intruder was vanquished, and the incubating Tern returned to its eggs. This occurred five times in ten minutes. Then, fearing possible injury to the eggs by the sun if I kept the bird away from its nest much longer, I removed the trap. Both birds were back incubating their rightful eggs in perfect amity the moment I retired to the blind.

CONCERNING RETURNS

As much time as possible was spent during the past season in trapping adult terns, mainly in the hope of procuring returns. By means of drop traps set over the nests, 1322 adult Common Terns were taken, of which 83, or 6.3 per cent proved to be returns. Thirty-seven of these birds were banded originally as adults during the past four seasons, while the remaining 46, or 3.5 per cent of the whole, were banded as nestlings.

There have been banded on Tern Island and the other Cape Cod rookeries, in the ten seasons from 1922, when the work was started, up to and including 1931, 30,910 juvenile Common Terns. Adults have been trapped only since 1928. In the four seasons preceding the one just passed 1230 adult Common Terns were banded. Thus there have been banded twenty-five young terns for every adult, and, were the mortality rates equal for each group, it would be logical to expect the ratio to hold in the birds captured as adults. But among the returns there are but 1.4 birds banded as juveniles for each one banded when adult. To express it another way, of the birds banded as adults, 2.8 per cent were retaken this past season, while of the thirty-thousand odd banded as juveniles, but .1 per cent were captured. This is simply another indication of the high rate of mortality in Terns during their first year, and the comparatively low rate after maturity is attained.

From the distributional standpoint this year's returns of Common Terns are very enlightening. Returns in the past have fallen into the following categories:

1. Terns banded as juveniles on Tern Island and recaptured nesting on Tern Island.
2. Terns banded as juveniles on Tern Island and recaptured nesting on other near-by rookeries—Billingsgate Island, Hopkins Island, and Pamet River.
3. Terns banded as adults on Tern Island and recaptured nesting on Tern Island during following years. Likewise Terns banded as adults on the Billingsgate Island,

Hopkins Island, and Pamet River rookeries and retaken breeding in subsequent seasons on the same rookeries where they were banded.

The logical inferences from these returns are:

A. Terns may return to breed on the island on which they were reared.

B. Terns may return to breed in other rookeries in the general vicinity of the one on which they were reared.

C. Terns may return to breed in the same rookery in successive years.

This summer Terns banded as juveniles on Tern Island were recaptured, in addition to the localities named above, on Egg Island in Lewis Bay, on North Point (formerly known as North Beach), Chatham, and in the new colony in Nauset Marsh. One Tern was captured on Tern Island which was banded in July, 1925, as a juvenile bird in the colony at the north end of the Cape Cod Canal in Sandwich, thirty miles away. This rookery is only five miles farther westward from Tern Island than the Pamet River rookery is northward, but the return is of special interest because it is the first and only one of a bird banded elsewhere as a juvenile to be recaptured on Tern Island. Of more importance among this summer's returns are cases falling into the following category:

4. Three Common Terns banded as adults at Billingsgate Island in 1929 were captured breeding on Tern Island. Two birds banded as adults in 1929—one at Tern Island, the other at Hopkins Island—were taken in the Nauset Marsh colony. Seven Terns banded as adults on Tern Island—one in 1928, five in 1929, and one in 1931—were captured on nests at North Point, Chatham.

From these we may make a fourth inference, that:

D. Common Terns do not always return to the same rookery to breed in successive years, but may nest on other rookeries in the general vicinity.

There is a strong individual tendency in Terns, however, once they have established their nesting territories, to return to the same rookery to breed year after year. In every case but one of the recaptures enumerated above, the breeding sites where the birds were originally taken were not habitable at the time the birds were recaptured elsewhere. Hopkins Island still affords some surplus available territory, and the nesting there was a success this year, so there is apparently no reason why the bird which nested there in 1929 should have gone to Nauset Marsh, unless, of course, ecological conditions there seemed more suitable to its fancies. But the site of the 1929 rookery

at Billingsgate Island has washed away completely, and on the narrow sand-bar which has made up to the eastward of it there is not space for one tenth of the birds which occupied the old site, and the Tern Island birds were forced to look for a safer place to nest after the wholesale destruction of their first brood.

That the Tern Island birds did go to other rookeries and attempt to rear second broods after their first ones were destroyed is proved by the following eight returns. Each bird was trapped originally on a nest at Tern Island, and each one was captured from twenty-four to forty-two days later incubating eggs on its new site.

Banded at Tern Island	*Recaptured*	
on	*Place*	*Date*
June 6, 1932	Nauset Marsh	July 1, 1932
May 29, 1932	North Point	July 9, 1932
June 4, 1932	" "	"
"	" "	"
"	" "	July 10, 1932
June 5, 1932	" "	"
June 8, 1932	" "	July 8, 1932
June 15, 1932	" "	July 9, 1932

Thus it is evident that existing ecological conditions are of greater importance in determining the distribution of Terns at nesting time than are any latent so-called "homing instincts."

THE AGES OF BREEDING ADULTS

In a previous paper (*idem*, 1929) I attempted to show the average ages of breeding Common Terns from a number of returns taken on the breeding grounds, but the data at hand were insufficient to give more than a general indication of the probable trend. During the seasons of 1928, 1929, 1930, and 1931 fifty-one returns were taken by C. B. Floyd, myself, and other workers from this station, of breeding adults originally banded as nestlings, and forty-six more were captured this past summer. Thus we know the exact ages of ninety-seven breeding Common Terns taken at random in the various Cape Cod rookeries. They fall into the following age groups:

1 year old	1
2 years "	7
3 " "	36
4 " "	22
5 " "	14
6 " "	10
7 " "	5
8 " "	2

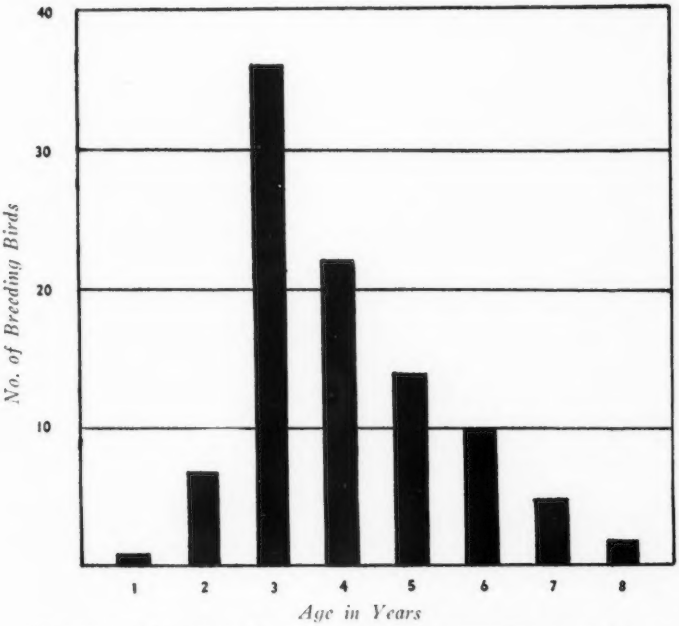

FIGURE 3. HISTOGRAM SHOWING AGES OF BREEDING ADULT COMMON TERNS.

The accompanying histogram (Fig. 3) shows that certain of the fundamental principles indicated by the data of 1929 hold true. Most Common Terns reach sexual maturity and breed for the first time when three years old, though a few breed when two years old. We now know that Common Terns may breed, though they very rarely do so, when only one year old, for a bird banded as a juvenile at Tern Island, July 5, 1931, was captured incubating eggs at North Point, July 7, 1932. We also know that Common Terns may breed when they are eight years old.

The histogram indicates that after the peak is reached at three years, the numbers of birds returning to breed each successive year drop off in a curve suggesting normal probability parameters. When we graph them logarithmically as per cents of an estimated limit, we find that they fall best into line at nine and one half years (Fig. 4). This does not means that

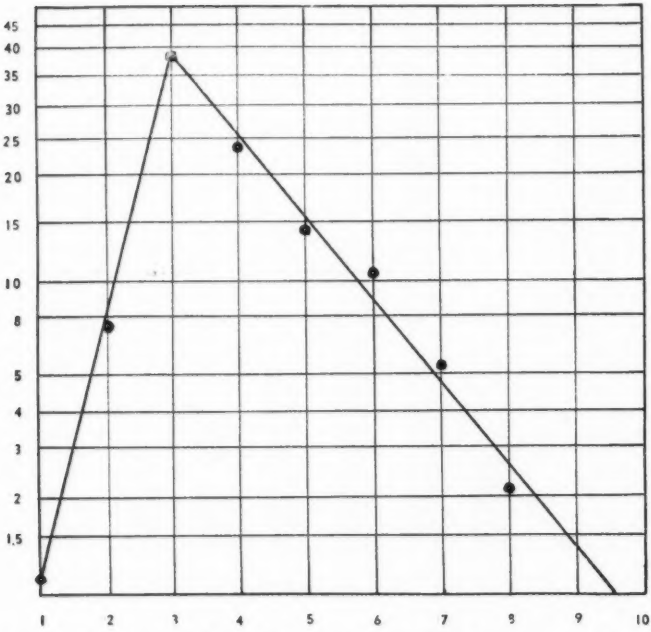

FIGURE 4. DATA IN FIG. 3 PLOTTED ON LOGISTIC GRID AS PERCENTS OF AN ESTIMATED LIMIT, IN THIS CASE NINE AND A HALF YEARS.

we may not find Terns breeding when more than nine or ten years of age, for we probably shall; nor can we postulate therefrom that a Tern has a normal life-expectancy of nine and one half years, for the average length of a Tern's life (though we cannot prove it from these figures) is evidently somewhat less than that. It does mean, however, that breeding Terns, after reaching the age of three years, decrease in numbers annually thereafter according to a definite, fixed ratio up to the age of nine and one half. This ratio is probably identical with the normal death-rate of adult Terns.

It must be borne in mind that these data are still imperfect in many respects, especially where they deal with birds banded previous to 1926. During that year, and in each subsequent breeding season, enough young were banded to permit a

small percentage of returns to be taken as a fair sample, which is, of course, impossible when but a comparatively small number were banded. While the figures in the above histogram fall nicely in a probability curve of parameters definite enough to allow logarithmic plotting, they are nevertheless subject to another factor, which, when taken into consideration, throws the returns for 1923, 1924, and 1925 considerably out of line. This factor is the number of birds banded each year. It is obvious that the number of returns taken in 1932 of birds banded in any previous year will depend directly on the number banded in that year. Hence the truest picture should be that of the percentage of returns for each year, rather than the actual number taken. But in order that the percentage of return may be considered as valid, it must be based on a sufficient number of birds banded to eliminate, or at least minimize, the percentage of error incident to the vagaries of chance. To illustrate: in 1932 ten birds were captured of the 5131 that were banded as juveniles in 1928, and two were taken of the 1000 young Terns banded in 1924. It stands to reason that the percentage of survival will be considerably greater in birds at four years of age than it will at eight, and yet in this case the .19 per cent return of four-year-olds, which is based on a very fair sample, is exceeded by the .20 per cent return of eight-year-olds, which is obviously in error and due to inadequate sampling.

However, the present figures are a vast improvement over those of 1929, and smooth out the age-curve considerably. Future figures should continue in like manner to lead us closer and closer to the truth as more and more young Terns are banded and the percentage of error in returns is lessened.

United States Bureau of Biological Survey,
North Eastham, Cape Cod, Mass.

STATE DISTRIBUTION OF RETURNS FROM BANDED DUCKS

FIRST PAPER—ALBERTA

By FREDERICK C. LINCOLN

KNOWLEDGE of the dispersal of migratory waterfowl from points of concentration is of interest to the student of birds, while it is also of decided importance to the official charged with their conservation and proper administration. Under the provisions of the Migratory Bird Treaty, the Biological Survey in the United States, and the National Parks Branch in Canada, are charged with this responsibility, which is ample explanation of the attention that is paid by these agencies to the banding of ducks and geese.

On July 1, 1932, the total number of migratory waterfowl that had been marked with Biological Survey bands was 98,948, and from these, important series of return records have been accumulated. It is planned ultimately to utilize this material in the preparation of technical migration studies of the different species. Such a report, treating the distribution and migration of the Mallard and the Black Duck is now in preparation. Since need for economy in Government printing makes it uncertain when publication will be possible, it seems desirable at this time to show briefly just what is being accomplished. Accordingly, in planning the present series of papers, it is the purpose of the writer to illustrate, by maps and short descriptive statements, the extent of the information that is now at hand relative to the movements of banded ducks.

The several States and Provinces where important waterfowl stations have been in operation will be treated in alphabetical order, beginning with the Province of Alberta. The maps will show the aggregate of returns received for all species, although the accompanying statement will indicate the numerical status of each.

ALBERTA

The banding of waterfowl in Alberta has been done chiefly by Paul E. Page, of Eagle Gorge, Washington, who operated a station at Lac Ste. Anne during the seasons of 1924, 1925, 1926, 1928, and 1929. Mallards were banded in largest numbers, but return records also were received for a few Green-

LEGEND FOR MAP

STATE DISTRIBUTION OF DUCKS BANDED IN ALBERTA

The banding area in Alberta includes Lac Ste. Anne, Leduc, Flat Lake, Camrose, Forestburg, Walsh, and Many Islands.

The lines extending into the several States and Provinces are not to be considered as indicating either routes of travel or the exact points of recovery, even where only a single return is listed for the State.

winged Teals, Blue-winged Teals, Redheads, and Lesser Scaups. Lac Ste. Anne is about forty miles west and north of Edmonton.

D. H. Bendick, of Leduc, about twenty miles south of Edmonton, banded ducks at that point in 1926 and 1927; Archie Hull, of Brigham City, Utah, banded a few Mallards at Flat Lake in the Lac la Biche district during July, 1928; T. E. Randall and Frank L. Farley banded several Pintails and Golden-eyes at Camrose in 1927; Randall banded a few Canvas-backs at Forestburg in 1928; and Alex Glennie banded a few Shovellers at Walsh and Many Islands in 1927 and 1928. Mallards, however, make up 156 of the 176 returns that have been received from ducks banded in this Province.

As is always the case when banding of game waterfowl is conducted immediately before or during the shooting season, there is a heavy local mortality, in the present instance the hunters of Alberta accounting for 55 of the records. These are all Mallards.

The data in this group illustrate how much the plains and Mississippi Valley States are dependent on the prairie Provinces of Canada for their Mallards, as of the 101 returns from points outside of Alberta, 74 are from the region east of the Rocky Mountains. The easternmost record, that from Ohio, is a Pintail banded at Forestburg. Of the 22 returns from Texas, 18 are Mallards, 3 are Pintails, and 1 is a Blue-winged Teal.

Curiously enough, despite the great importance of the Bear River Marshes in Utah, only one Alberta-banded duck has been recovered there. This was a Shoveller banded at Walsh in June, 1928, and killed in December of the same year.

The single return for Minnesota is of a Redhead that was obviously traveling the great flyway used by diving ducks *en route* to the waters of Chesapeake Bay and the South Atlantic coast.

The thirteen returns for the Pacific coast are for eight Mallards, two Lesser Scaups, one Canvas-back, one Shoveller, and one Golden-eye. The single record for Arizona is for a Mallard.

Biological Survey, Washington, D. C.

THE STATUS OF CAPE COD TERNS IN 1932[1]

By OLIVER L. AUSTIN, M.D.

THIS past spring and summer we have endeavored to obtain a comprehensive knowledge of the Common, Roseate, and Arctic Terns which for many years have made Cape Cod their breeding ground; to locate and survey all their nesting sites; to estimate the number of adults present; to determine by comparison with data obtained previously what changes have taken place in the colonies; to band as many adults and chicks as time afforded opportunity as a basis for future study; to decide what measures will avail to afford greater protection to these much harried species and encourage their return subsequently in greater numbers. This article deals with these undertakings alone. By the quadrat method, by trapping, and by observation from portable blinds information has been obtained which amplifies somewhat and corrects in part what had been known and written of the life-histories of these species. Another member of the station's staff is reporting on this phase of our work. A short bibliography is appended for orientating any one desiring locality descriptions or authority for statements made as premises for deductions.

Topographical changes made by nature's agencies in the long-used nesting sites of the larger colonies, destruction by predatory birds and mammals, molestation by the increased resident and summer populations, and the restrictions inevitable to advancing civilization have made ecological changes which this year have taxed sorely the adaptability of the Terns. It has been pathetic to observe the persistence of these birds in responding unintelligently to their greatest biological urge by relaying clutches when their first eggs and chicks had been destroyed, and it is evident that terns display far less protective reaction to experienced and possibly recurring dangers than do such a species as Starlings. Only one of the previously studied colonies has approximated its former numbers and raised its usual quota of young.

Unless the more desirable nesting conditions are restored by making necessary changes and giving adequate protection to the breeding birds, the colonies on Cape Cod will dwindle progressively. By their insistence in the Cape Cod areas on breeding only on islands or sandy peninsulas which are islands at

[1]Contribution No. 10 from the Austin Ornithological Research Station.

flood tide, the terns have attempted to utilize almost all the possible locations on Cape Cod, these being limited to the larger bays and off-shore islands. Adults captured and banded while incubating early in the year on islands, have been retrapped while renesting in localities which are a part of the mainland, safer sites not being available. The inexplicable tendency of terns to return to the locality of their birth or former nesting, results in their illogical acceptance of altered conditions which increase jeopardy. Vegetation overgrown beyond the extent requisite to adequate shelter from the elements limits the number of nests possible in a given area, affords a retreat for predators, and, by restricting the vision of adults, curtails maximum feeding of their chicks by increasing the time spent in locating them. Islands denuded of vegetation by storms entail increased mortality of chicks by exposure to rain, cold, and, especially, excessive heat. Blindness which results in the death of many chicks appears to follow lack of shelter from the cutting sand driven across spits by frequent high winds. One afternoon chicks were found almost completely buried by gale-driven sand. The greatest concentration of nests is not on the fields of dried thatch deposited by spring tides along the beaches and not on the barren spaces, but in areas sparsely grown with beach-grass or scattered plants, especially if nesting material is close at hand. An isolated bush of dusty miller is usually surrounded by nests very close to one another, and its dense spreading branches are found to cover a considerable number of hiding young.

An adequate food-supply appears to be in proximity to all the rookeries and it is unusual to find terns fishing at any great distance from known nests. When the preferred sand-eels decrease, large schools of small fishes substitute generously. In 1930 minnows of several species comprised the greater part of the dietary of the Tern Island colony.

The immaculately clean terns find great enjoyment in fresh-water bathing. Close to Tern Island is a lake in which at all times may be found flocks of birds fluttering and preening contentedly. Similar ponds are near the other large rookeries.

These are but a few of the many desiderata requisite to making Cape Cod a favorite summer residence for terns. It is thought that the former large colonies can be restored if the adverse conditions can be eliminated or at least minimized, and further, that islands close by be made attractive to the thousands which a few years ago bred on the now uninhabited and birdless islands in Pleasant Bay. At least there will be no almost total annihilation of the hatched chicks such as occurred

this year on one large island. Since terns are unequal to safeguarding their own security or that of their young, it behooves conservationists to act for them.

There are but five large tern colonies on Cape Cod—Tern Island at Chatham, Pamet Island at Truro, Billingsgate Island and Jeremy's Point in Massachusetts Bay, and Egg Island in Lewis Bay. The last alone has been equal to accomplishing the normal increase of successfully reared chicks. Billingsgate appears to have matured a small percentage of its expected quota. It is believed that almost none of the comparatively few young hatched on the other sites have survived to fly away with their parents. The apparent etiology of these occurrences will be offered.

Smaller groups have bred precariously on Hopkins and Rocky Islands in Nauset Inlet, also on one small, high islet in Pleasant Bay. The few pairs formerly nesting on an island near Cotuit did not return this spring. The frequent incursions of a dune-climbing sight-seeing bus disrupted the home life of the Monomoy Point flock. The storm that two winters ago leveled into a low, bare beach the dunes at the tip of Nauset Point, last summer compelled the birds customarily nesting there to establish a new home on the sandy yet heavily grassed banks off Nauset Inlet. This colony has returned. A portion of the Tern Island group with keener reactions than their clansmen, having lost either eggs or young, moved to North Point (formerly known as North Beach), a short distance to the eastward for their second attempt at reproduction, thus founding the youngest of our colonies. A few pairs may breed at undiscovered isolated points, but we have been unable to locate their nesting sites.

The elemental forces that inexorably are shoaling Massachusetts Bay determined long ago the obliteration of the tern colony of thousands that fifty years ago thrived on the outskirts of the forty dwellings, the schoolhouse, and the lighthouse supposedly firmly foundationed on Billingsgate Island. The assistance given them by the "mackerel gulls" in locating schools of desirable catch, induced the tenanting fishermen to afford these terns protection from plumage-hunters. Humans and birds thrived because the necessities of both were attained. As the surrounding deeps shallowed, thus increasing the eroding force of the winter seas, nesting sites and human dwellings disappeared together into the Bay with progressively increasing rapidity until, when I visited the island for the first time in 1929, there remained but the skeleton of one small house and the nests of at most fifteen hundred birds on the

two small parts into which the remaining land had been divided. Early in July that year, at the peak of the hatching season, the wanton vandalism of a party of picnickers, in a dire few hours, obliterated every procreative hope of the colony. With unreasoning courage, in 1930, a smaller aggregation returned to the home-site on the remaining half of the preceding summer's territory. A warden spent at least a part of each day there in an effort to maintain sanctuary, but each night he reported a dwindling of both eggs and chicks, and he believed sand-print evidence proved Black-crowned Night Herons and gulls to have been the new malefactors. A devastating storm, just before spring last year, offered the persistent birds only a sparsely grassed sand-bar for nesting. Four hundred and eighteen chicks were banded there in July, 1931, but the greater part of these perished a little later during a few days of alternating burning sunshine and torrential rains. This year's first visit to the locality, on June 16th, showed that the returned remnant of the colony, augmented by a few banded refugees from other harassed rookeries, had made 190 nests on the grassless sand-spit projecting but a few feet above high-water mark. The ensuing spring tides washed away more than half of these nests. Early in July visiting fishermen brought us sad tidings of the large number of dead chicks then strewn about the blistering, unshaded sand. At the time of our final visit, July 13th, there were six chicks just emerged from their shells, 492 recently laid eggs in new nests, but not one survivor of the 88 previously banded young could be found. It is expected that next May any returning birds will find land there at low tide alone. Only the lapse of many years, together with some unpredictable reversal of nature's ways, will suffice to rebuild Billingsgate Island, reëstablish favorable ecological environment, and, perhaps, eventually re-create its pristine prosperous tern population.

Jeremy's Point, a peninsula less than a mile to the north of Billingsgate, for years has been the forlorn hope of another colony. Impelled by some urge as preposterous as it is inexplicable, not oriented by previously experienced calamities, the birds have reappeared here annually to the number of from one to three thousand, hopefully courted, mated, scratched out nests in the sand, and laid eggs at the usual rate. At exactly this period every year, skunks and cats have come out from the mainland to devastate by their feasting. Once a futile attempt was made to avert this catastrophe by building a wire fence across the base of the point. On June 16th, this year, not over fifty adults voiced their unmistakable cries of distress

over the Point, although several hundred typical nest-bowls, littered with broken egg-shells, demonstrated the usual endeavor to replace the normal annual death of adults. Numerous identified tracks bore evidence to the unfailing memory of the predators. As if to compensate for the obliteration of Billingsgate, the wind-driven seas of last winter cut a channel across Jeremy's Point at its neck, as yet bare enough at low tide to permit the crossing of the egg-eaters. However, it is the first dredging of a run which next winter's work should, with corresponding certainty, deepen sufficiently to convert the Point into a true island. Then, possibly, the Tern's persistence will be given safer opportunity for the accomplishment of its purpose. It is hoped that nature's unceasing effort to maintain, ultimately at least, ecological balances may be depended on to replace what some of its forces have obliterated.

The ability of colonial birds to survive ceaseless and diversified persecution has been demonstrated at Pamet Point, which is an island only at flood tide. Here, according to observing residents, the Tern population formerly equalled those of Pleasant Bay and Tern Island. A gradual reversion from insular to mainland conditions, increasing its accessibility to human and four-footed disturbers, determined a progressive shrinking of the nesting population. In June, 1929, the greater part of approximately five hundred adults had nested on the leveled tops of the moderately grassed dunes. But swarms of ants, at the moment of the first pipping, swarmed into the shells to devour the chicks before they could emerge. An immediate resort to tobacco dust and ant powder rescued a small percentage of the hatch. In 1930, a slightly larger group of terns nested preferably amid the thatch and litter on the beach. The total possible banding of 192 chicks inspired our placing a warden on the island during July to make recounts and discover the factors determining the colony's failure. At once it was found that large numbers of well-rounded rats were living in the accumulated débris, boldly, even during daylight hours, killing and feasting on older chicks and adults. In seven days eight large black snakes were killed, autopsies demonstrating their appreciation of a young tern diet. Each morning exhibited fresh tracks made during the nocturnal visitation of cats from the houses of the summer residents close by. Every clear day, several clans of visitors came to dig clams on the inside mud-flat, bathe from the outer beach, and picnic on the dunes. Their uncontrolled children molested the chicks and investigated the degree of incubation of the eggs, while the accompanying dogs harried the young and barked at resent-

ing parent birds. The warden's protests provoked either mirth or abuse, for Cape Cod convention includes no respect for the sanctity of any man's real property. Additional depredation was committed by owls, which twice left identifying pellets. To complete the ruin, an early spring tide washed away all chicks and eggs that had survived on the beach. The former adverse conditions continuing in 1931, only 125 chicks were banded, in spite of careful searching by organized parties. This spring the flock returned to face the same total of insuperable odds. On June 10th five hundred cheated birds were flying, protestingly, high over the amazingly few nests, which contained a mere handful of whole eggs. The wildness of these birds and the manner in which a great number of shells had been broken indicated human robbery. Not far away live some Portuguese and Finns who are suspected of not having been Americanized from their native custom of egging. While the protective reactions of terns are almost negative to long-drawn-out persecution, no matter what the season aggregation may be, whole colonies will move to a new site after one sudden overwhelming cataclysm. History tells of this having been done by the Chatham, Hyannis, Nauset, and former Harwich colonies when their rookeries had been washed away completely by a storm-driven, unusually high tide.

At Hopkins Island, exuberant vegetation is the only determined handicap, yet, anomalously, it appears from estimates and a greater number of nests that the adult population has actually increased this year. The formerly low oak, rose, and bayberry bushes have proliferated into a dense, high thicket covering the sides and a greater part of the top of the island. Encroaching outwardly from the base, the thicket has restricted the littoral conditions essential to the nesting of the Arctic Terns that had constituted a high percentage of the colony and which this year is definitely smaller. A thick mat of tangled poison-ivy, rose bushes, and blackberry vines has replaced practically all of the former meadow on the flat summit. The perfect cover afforded the young, while it makes their banding a patience-trying task, may explain why the birds are less quarrelsome there than elsewhere, as it does, also, our having ringed more chicks there this year than last.

The almost constant passing of noisy motor-boats with their raucous passengers is converting Rocky Island into a natural tombstone for its erstwhile prosperous and contented, although small colony. Not more than fifty adults circle constantly high in the air, having learned grievously the folly of swooping down at the heads of intruders in characteristic tern manner.

Twenty nests, one dead adult, four living and three dead chicks epitomize our findings June 23d.

Four years ago, Nauset Point, then a series of low, beach-grassed dunes, harbored several hundred birds, unmolested in spite of their direct accessibility from the mainland. The gales and eroding seas of the following winter leveled the dunes into a low, bare bar. In May, accompanied by twenty pairs of Least Terns, the colony returned to lay eggs in unlined nests on the drifting sand. The inevitable, inexorable June high tide, in a few hours, washed into the Atlantic the birds' total accomplishment. Last year four, and this year six, indomitable pairs have nested there, to an identical undoing. It is thought that, in the process of evolution, a species alters its habits to secure adjustment to regularly recurring, periodic conditions. Probably by reason of their recognized low adaptability, an insufficient number of generations of terns have been bred to develop instinctive reactions to the folly of nesting within reach of the monthly recurring spring tides.

In 1930, this Nauset group, augmented by discontented or sex-balancing recruits from other clans, formed a new colony on a sedge-grown mud-bank bordering Nauset inlet, a half-mile landward from its old home. This terrain differs so decidedly from any which Terns had been known to utilize that memory of a year-old catastrophe must have induced its reluctant acceptance. Unfortunately, its level is perilously little above the greatest high-water mark. Independence Day, there were 73 nests containing 143 eggs and 41 chicks (the clutch averages thus above the normal) with a suburban group of 11 nests and 25 eggs. No ascertained mishap depreciated the maximum success of this nesting. On June 28th this year, before the final egg-laying, the main colony had grown to 153 nests with 338 eggs and 22 chicks, while the suburb had increased to 226 nests, containing 507 eggs and 18 chicks. Any interpretation of these data should take cognizance of our having trapped here, early in July, an incubating adult which we had trapped and banded while similarly occupied at Tern Island late in May.

Each year, in May, several thousand Terns are observed resting in compact groups on the beaches of Monomoy Point. This has led to the erroneous inference that the entire group had selected this not entirely unsuitable location for its nesting site. A number of over-ardent or forgetful pairs are inveigled into remaining here to nest on the broad beach, but the great number divides into flocks that scatter out to the respective nesting areas that, before departing from the tropics, memory and instinct had made their destinations. Jutting out into the

Atlantic, Monomoy makes an ideal landfall. It were better the nesting birds had passed on, too, for increasing numbers of heedless sight-seers spy on their strutting courtship, crush their eggs, and disrupt the chicks' essential feeding schedule.

The mention of "mackerel gulls" to an interested older resident commonly elicits inquiry concerning specified islands in Pleasant Bay, where, he asserts, these birds have always congregated in numbers suggesting hyperbole. This summer, exploration of all these islands determined that human occupancy had driven the terns from all save Little Sipson. Here 70 adults asserted ownership of 38 eggs and one lone chick at least two weeks old.

Tern Island, supposedly the largest, most successful, and best protected of the Cape colonies had been selected for detailed and extensive study this last summer. We visited it almost daily from before the arrival of the first migrant until it was probable that not one more living chick would be found, at first hopefully endeavoring to avert threatened disaster and finally compelled by our undertaking to witness the grievous details of a great tragedy.

Well before the prompt coming of the vanguard on the anticipated day to preëmpt the choicest sites, experimental quadrats had been taped off and observation blinds erected. The island was explored thoroughly to ascertain the absence of predatory mammals, and red squill distributed generously for precaution's sake. Our first disappointment was finding that the winter storms had failed to comb out and thin the tangled mass of accumulated, dried beach-grass. The terns increased rapidly, but the daily aggregate was invariably much below that on the corresponding day of previous years. On May 3d a sudden large influx of terns encouraged the hope that the completion of an unexplained delayed migration would swell the total to its usual peak. Finally, our collective opinion admitted reluctantly that the adult census was uniformly one-third below that of last year. Observations and trapping elsewhere did not indicate the presence of an abnormally high percentage of banded members of the Tern Island flock. In mid-June, concurrent with other ominous events, a decided decrease was noted. This progressed geometrically, until on July 6th by a most liberal estimate, of the former ten thousand adults, there remained but a scant hundred and fifty chickless parents flying aimlessly over the deserted nesting ground or standing on the bordering sand-bars.

In the spring, courtship having ended and mating having been consummated, egg-laying proceeded at the usual rate to a

total commensurate with the size of the colony. There was increased concentration of nests in the more open spaces with a decrease of nests in the overgrown stretches. Very few were found in the grassed sector formerly occupied by the Roseates. About June 12th, coincident with the beginning of hatching, broken shells with missing contents were observed and eggs began to vanish mysteriously in the quadrats where eggs were being counted daily. From one select open tract practically all the eggs disappeared in a few days. Questioning the near-dwelling fishermen, whose pride in the colony equaled our own, eliminated egging. Then, in a compact group, close to some litter, we found eight violence-killed adults. The advent of rats was suspected, but neither burrows nor tracks could be found and the red squill bait remained untouched. A second planting of this usually effective poison was not eaten.

Hatching proceeded, and about one thousand chicks were banded within a few days. Immediately these began disappearing as inexplicably as did the eggs. The vanishing of the freshly emerged chicks increased, and possible bandings dropped to 80 a day, then to 33, and finally the last living chicks found were 11 on June 30th. (In 1931, 2050 chicks were banded after July 1st.) Subsequently, the island was searched repeatedly, but not one clump of grass sheltered a hiding infant, not one well-grown juvenile could be found on the beaches or in the water where our photographs show them congregated in thousands at this same time on previous years. Last year, after a late storm, nearly five hundred bands were removed from dead chicks in two days; this summer only 87 were salvaged from a total banding of 1754. In 1931, 6130 bands were affixed to living young aside from the several hundred reapplied after removal from those deceased; this year, the number of unbanded corpses aggregated less than one hundred. From our quadrat in the heavy grass the last egg and chick had disappeared in thirty-one days after the first laying. The complete encircling of another quadrat with an eighteen inch wire fence, its bottom buried in the sand, neither lessened nor explained what was happening.

Consequent to the defeat of its endeavor, the preponderance of the colony departed promptly, while the persisting few began a rapid but ill-omened laying of uniformly smaller second clutches. This was not done on the former usual sites, but on the expanses of drifted thatch near the water-line and in the dense green water-grass at the northern tip of the island, where inundation by the next high tide was inevitable. Strangely, almost two hundred fresh eggs were found in our three re-

maining small quadrats and nowhere else in duplicating terrain on the plateau of the island. Frustration was the sad end of this brave but forlorn effort, which merely encouraged the destructive agencies in continued vandalism. A few days sufficed to accomplish the destruction of the quadrat eggs.

The increasing incidence of dead adults subsequent to discovery, in June, of the first group, especially close to accumulated débris, forced a third search for quadruped predators. Traps hidden in the mouths of freshly made burrows immediately captured four huge, corpulent rats, and a fifth was seen racing to a matted-grass refuge. Thus orientated we combed the island, exposing many newly dug rat-holes hidden by bunches of tangled grass, and discovered the characteristic method of egg-opening. These rats had been bred beneath fish-houses on the mainland shore and in the near-by town dump. Hunger, engendered by a scarcity of fish offal and an early burning of refuse, had inspired migration to the island's bountiful feast. Game Warden Mecarta had seen one rat ferried across on a raft of drifting thatch.

Finis was affixed to this pathetic chapter of Tern Island's history on June 14th, when not even one dazed adult, not a solitary harassed chick, not a single fertile egg was found there to recall memory of May's inspiring and optimistic picture.

Twenty years ago an enormous number of terns bred in peace, as had their forebears, on North Point, then a long, half-mile wide stretch of grassy dunes and beach located a short distance oceanward from the then birdless Tern Island. Twelve years ago, a winter with unusually violent gales and an undermining surf leveled, shortened, and narrowed this site into a flat sand-spit which succeeding milder seasons undulated slightly and vegetated sparsely. The returned homeless colony evidently sensed the inviting suitability of close-by Tern Island, for immediately it founded the rookery which has continued there in progressive prosperity until this summer. Accounts of several duplicate movings of the Cape's Tern colonies have been gleaned from older local observers.

When, in June last, the bulk of Tern Island's thwarted tenants sought safer environment for its second attempt, subconscious instinct evolved from ancestral experiences may have been a factor in the selection of North Point. Shortly they began brooding the contents of over a thousand nests containing two or three eggs. Then, for the possible purpose of teaching by experienced misfortune, the Fates permitted no surcease in the chastisement of this colony. Whenever birds left their nests to fish, the strong prevailing southwest winds buried the eggs beneath drifted sand.

On July 3d, the owner and the pilot of an airplane (whom we succeeded in having apprehended and fined) seven times in rapid succession landed their craft in the center of the colony, crushing eggs, killing newly hatched chicks, and terrifying the adults. On the 13th, after a single day's absence, our approach foretold the final climax of the whole tragedy by the winging from the Point of less than one hundred birds. Only two score widely separated unviolated nests had survived; the sand was fouled with a litter of broken egg-shells and their former contents, and there were no chicks to band. Approaching many of the former nest-sites were the tracks of Black-crowned Night Herons, which had come to scavenge the remains. The only ascertained clues to the cause of this disaster, unless it was the result of the ecologically sound resort of some species to unusual food by reason of a shortage of its customary supply, were the tracks of people and also those of an enormous dog.

I cannot offer satisfactory explanation for many of the details of these occurrences nor even suggest adequate major causes, although our station's assumption of guardianship over the Cape's Terns spurred us to our maximum effort. Possibly better informed or more experienced readers can offer an interpretation. By means of carefully made autopsies on all the dead adults found, also on a sufficiently large number of dead chicks, the possibility of disease being a factor of epidemic magnitude was eliminated absolutely. Similarly, starvation resulting from a curtailment of the usual food-supply was ruled out, this condition being substantiated by repeated observations of the fishing habits of these terns in comparison with those of preceding seasons. The rat invasion, as on unforgettable former occasions worked great havoc, but it cannot account for the wholesale vanishing of hundreds of chicks as if by legerdemain. Digging out burrows to their last ramification did not reveal the presence of one feather, bone, or egg-shell. Although we raised, in captivity, two Great Horned Owl chicks, hatched this spring near Tern Island, this species was not sufficiently abundant to have been any more a factor there than it was at Egg Island, where we found freshly regurgitated pellets, but where the damage done by it was negligible. Provincetown's enormous flock of resident Herring Gulls, consequent to the curtailment of their food-supply this spring by the waning fish industry, scattered widely over the Cape's shoreline. Augmented to unprecedented thousands by immigrants and accompanied by hundreds of recently recruited Laughing Gulls, they rendezvoused in such evident amity with the terns on the rookery beaches that they must not be suspected of having developed predatory habits. Their tracks

were never seen in vandalized areas. Unilluminating were our night vigils in the colonies prompted by rumors of Night Heron marauding, nor was incriminating evidence found by scuitinizing regurgitated stomach-contents in Chatham's large heronry. Our aggregate tern census has remained too constant to warrant considering this a recurring cyclic variation of ecological origin. The influx of Gulls, the decreasing number of Night Herons, and radical changes in the numbers of other species, together with many important and apparently permanent alterations of environmental conditions, suggest the possible beginning of a realignment of Cape Cod's avian population with an ultimate crowding-out of the terns.

Lovely little Egg Island, æsthetically exquisite as any vaunted coral isle, serenely and protectingly nestled in the center of the southern corner of Lewis Bay, and ecologically ideal for Terns, fosters the Cape's most prosperous colony, which numbers over five thousand adults. Formerly occupied, abandoned, and then refounded ten years ago, evidently by exiles from Monomoy Point, it has utilized its unique and essential environment through progressive achievements to this year's inspiring success. No disaster originating in the elements, no known persecution by humans, no appreciable molestation by predators halted the raising of 5433 banded chicks into flying juveniles. Only 132 dead chicks were found; not a dozen unhatched eggs were counted on our last visit.

Man's protracted machinations almost approximate the uncommon and short but cataclysmic elements in the inhibition of tern procreation. It can not be expected that uninterested residents will sacrifice even one small financial gain to the accomplishment of a sanctuary for terns, nor that the increasing hordes of tourists and summer visitors will forego satisfying their idle curiosity by inevitably destructive and disrupting trespasses into these bird-nurseries. An egg-fight on North Cape or Monomoy is counted the gala event of a summer by the boys of one near-by camp. Intellectuals from Chatham resented being rebuked for bringing their spaniels to Tern Island. Adequate wardenship affords the only possible remedy, but only where conditions are absolutely insular; elsewhere the certain nocturnal invasion of quadruped predators will nullify all custodial endeavors.

A successful Tern colony is such an ideal open-air laboratory for the investigation of the biological principles underlying bird life, so much moral uplift and satisfaction of any inborn appreciation of beauty is consequent to daily close contact with the dainty "sea-swallows," that our station is committed without

reservation to its maximum effort for the preservation of these species. Next May the returning colony of migration-wearied birds will find Tern Island restored to a reduplication in detail of its original environmental desirability.

TERNS BANDED IN 1931 AND 1932

	ADULTS						CHICKS					
	hirundo		*dougalli*		*paradisaea*		*hirundo*		*dougalli*		*paradisaea*	
	1931	1932	1931	1932	1931	1932	1931	1932	1931	1932	1931	1932
Tern Island	77	704	2	1		2	5085	1716	1045	38		
Egg Island		53		1			1721	4220	55	1205		
Billingsgate		52					418	118				
Jeremy's Point		0						0				
Pamet River	31	9			4	3	125	5				
Hopkins Island	9	1					122	161				2
Rocky Island		0					40	4				
Nauset Inlet		126					41	108				
North Point		286				1		255				1
Little Sipson								1				
TOTALS	117	1231	2	2	4	6	7552	6588	1100	1243		3

	Total Banded			*Returns*
	Adults	*Chicks*	*Total*	
1931	123	8562=8775		1931 18
1932	1239	7834=9073		1932 62
	1362	16486		

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A STUDY OF TWO NESTS OF THE BLACK-THROATED GREEN WARBLER

By MARGARET M. NICE and L. B. NICE

PART II: CHRONICLE OF THE AUGUST NEST

IT must be confessed that the discovery at 5:05 P. M. on July 26th of another nest of this species a quarter of a mile to the east of the first did not evoke quite the same enthusiasm as had the event of July 9th. This nest was thirty feet up in an ancient hemlock, fifteen feet from the trunk; I climbed the tree and found it was impossible to examine the contents. The female appeared chipping, and soon the male arrived, only to be driven off by his mate. At 5:15 she settled on the eggs, but when her mate came almost to the nest, she left to chase him off. Ten minutes afterwards she approached the nest but darted away, repeating the process two minutes later. The male flew down past her, and she pursued him. Twice again she neared her nest but turned back, and twice again she chased her mate before I left at 5:42.

Incubation. Ten hours were spent in observation during incubation, but the results were far from satisfactory. The nest was so well concealed that usually it was impossible to be sure whether or not the female was on the eggs. She was also much more timid than the other bird, but her distrust showed itself in such an unusual way that I did not at first take the necessary precautions to allay her fears. She did not chip after the first day until after the young were half-grown, but she sometimes, although not always, refused to stay on the nest after returning to it unless I had left my usual seat, in plain sight twenty feet to the north of the nest, and had hidden myself under a distant hemlock. That my presence did not prevent her from leaving the nest was shown on August 2d, when she departed two minutes after my arrival.

On July 27th, 29th, and 30th there was one twenty-minute absence each day, and on the latter date a period on the nest of more than 78 minutes, although the temperature in the woods was 80° F. On August 2d there was one absence of 15 minutes, and on August 5th there were absences of 15 and 13 minutes and one period on of 99 minutes, although again the temperature was around 80°. The incubation periods of this bird were much longer than those of the first female. Again there is evidence of shortened absences the day before hatching.

This male sang in the nearest hemlock grove, but as this was seventy yards from the nest, it was difficult for me to hear more than the two highest notes of his song, and I suppose much of his singing never reached me at all. He was singing on July 30th, but on August 2d and 5th I heard only series of chippings from him, apparently signals to his mate to leave the nest and join him. I have no later evidence of his presence.

Care of the Young. On August 6th the female left at 8:06. I retired as usual, but unwisely left my pillows in full sight, and they proved as disquieting as my own presence would have been. At 8:25 she visited the nest but dashed away; I expected a prompt return, so waited, but finally at 8:58 I concealed the offending objects and went back one more to my hiding place. At 9:03 she alighted within ten inches of the nest, sat there for two minutes apparently listening to the screams of a Red-tailed Hawk (*Buteo borealis borealis*), and then went to the nest. At 10:26 she left, and I did likewise, making my pillows into an inconspicuous pile; in fifteen minutes she returned and went directly on the nest, leaving again fifteen minutes later. At 10:15 she returned with food for the first time since my arrival at 7:40, then brooded quietly till 10:53. This time I stayed, as the female returned with a small green larva; she started to leave at sight of me, but turned back and fed and cleaned and inspected for about four minutes, then left to the south. The young must have hatched before my arrival, for I saw no manipulating of egg-shells.

I watched till 12:26 and again from 1:35 to 5:15; she brought fourteen meals in all, but strangely enough brooded after only eight of them. The explanation of her erratic conduct might have been nervousness (although she did not appear to pay any attention to me) or perhaps inexperience. The temperature was 70° in the morning and 80° in the afternoon, considerably warmer than on any of the subsequent days of nest life.

On August 7th, 8th and the morning of the 9th, the female had settled down into the typical routine of brooding after practically every meal, as will be seen by the chart of her activities. She brooded considerably more than the first female, but this was probably due to cool weather—from 66° to 76°. Her rate of feeding for the first four days ran much the same as at the first nest—once every 30, 31.2, 30, and 25.7 minutes respectively, but on the 10th it was much more rapid, once in 18.6 minutes. Like Female No. 1 (although a day later in the cycle) she suffered a relapse on the following day, feeding once every 30 minutes during three hours on the next afternoon; if observations had been taken also in the morning, the rate might not have

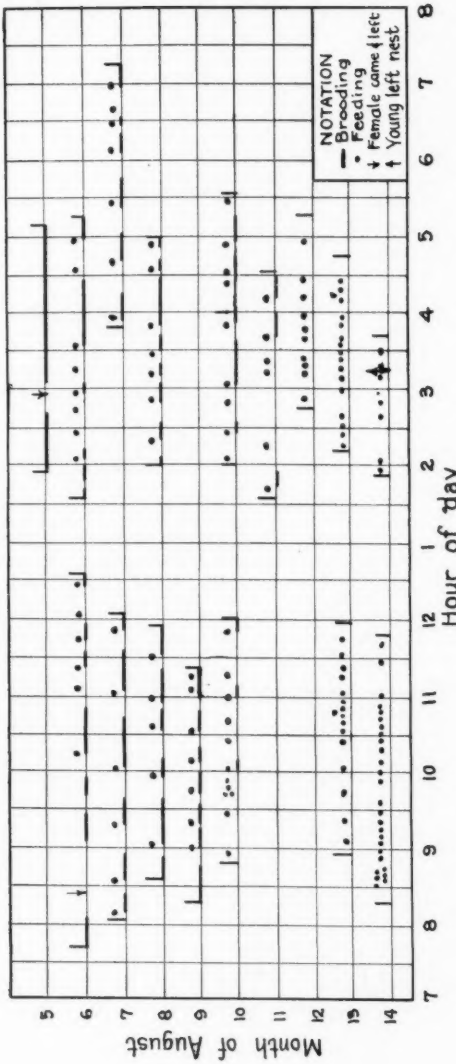

CHART II

INCUBATION, BROODING AND FEEDING OF THE SECOND FEMALE

been quite so slow. The average rate of feeding during the 32¾ hours observation of the first six days was once every 26.9 minutes, almost the same as that during the 52 hours of the first six days at the other nest, once in every 25 minutes.

During these first six days the female was heard to chip on only one occasion—two chips at 10:58 on August 8th. On the 9th she chased off a Chickadee (*Penthestes atricapillus atricapillus*), but as soon as she had left, the Chickadee came to the nest and looked in. A red squirrel lived in the vicinity and every day scolded me at length from the nesting tree; but the Warbler showed no concern. On the 10th I first noted a baby's head raised above the nest, and the next day both were occasionally visible. On the whole, the female was silent, never present in the vicinity between the infrequent meals she brought, and only occasionally showed originality in approaching and leaving. But the afternoon of the 12th she showed a greatly increased rate of feeding—once every 13.5 minutes; also before the second feeding at 3:16, the female chipped vigorously for three minutes, although at all other times she was silent. The young for the first time were noisy.

The next day the female seemed like a different bird. She chipped, often with great vigor, at all but four of the 32 feedings; she spent much of the time in the vicinity, gathering food near by instead of far away, she fed on an average of once every 10.3 minutes, and she evinced much originality in her methods of approach and departure. The morning of the 14th she showed the same behavior to an even greater degree, chipping that sometimes became vehement being given in connection with all but two of the 27 meals, which were brought at average intervals of once every 7.7 minutes.

Early in the morning the young reacted to their mother's arrival when she was ten inches from the nest, by mid-morning at a distance of eight feet, and by noon the moment she came into the tree. At 8:43 I noted they were greatly excited, and at 8:45, 10:08, and 10:25 that they nearly left the nest. At 8:45 the female after feeding returned to the nest chipping very loudly as if to stir up the young.

I left at 11:48, and upon my return at 1:55 found that one baby was in the branch two feet below the nest calling constantly, while the nest baby was quiet. The female, giving about one chip a second, carried a tiny larva to the baby, but flew off, returned, and then darted away. A Red-eyed Vireo approached the nest; the Warbler dashed at it but it refused to leave. In the excitement the baby fluttered to the ground, and his mother followed. I went to look at it, and she became perfectly frantic,

flying around and about in a great circle, chipping desperately, fluttering her wings very fast, with her tail spread and drooped, as she dashed about over the ground. I returned to my seat, and the baby, who had kept absolutely quiet, started to climb a stick. His mother came hurrying to him, guarding him and encouraging him away from danger. He progressed by big hops, sometimes aided by his wings, and soon was out of sight.

At 2:38 and 2:49 the nest baby was fed and at 3:17 it clambered out of the nest and stopped two or three inches away. Two minutes later the female came with food, approached the baby with loud chips, but darted away. The baby tried to follow but fell a short distance, while the female flew about; it made another attempt and tumbled to the ground. She flew down and hurried it to the south, so that in a few minutes it was one hundred feet from its birthplace.

My husband climbed the tree to poke the nest down, and the female came flying back protesting. As with the other warbler, the tie with the nest was not immediately broken by the leaving of the young.

The chipping of the female was a matter of excitement, sometimes due to fear, at other times evidently a stimulus to the young to be up and doing. Although to my ears the notes did not differ except in rapidity of utterance and in loudness, the young reacted in directly opposite ways according to whether a warning or encouragement was intended. There were two clear cases of warning, the one already mentioned when I went to look at the first little bird after it had fallen on the ground, and the day before, when the female chipped after each one of the distant screams of a Red-tailed Hawk, the young subsiding into the nest. In the first case the chipping was the most violent I ever heard from this bird; in the second it was rather subdued.

How much of her almost constant chipping during the last two days was incited by distrust of me, and how much was a normal expression of excitement over the imminence of the fledging of the young, it is impossible to say. On the afternoon of the 14th before I came in sight of the nest I heard loud chipping that could have had no connection with myself. It may be that much of her vociferations in my presence expressed a mild degree of disturbance that called forth no response in the young. Her silence during the first six days and her clamor during the last three reflected the normal rise of parental devotion.

TABLE II

ACTIVITIES OF THE FEMALE AT THE AUGUST NEST

AUG.	HOURS	BROODING			FEEDING		EXCRETA	
		Per cent of time on nest	*Average length brooding*	*Average time off*	*Number times fed*	*Rate of feeding in minutes*	*Eaten*	*Carried*
6	7	50.7	21.1	27.1	14	30.0	?	0
7	7¼	59.1	21.3	15.4	13	31.2	1	0
8	6	62.9	19.3	11.2	12	30.0	?	0
9	3	54.2	14.2	13.7	7	25.7	?	0
10	6½	19.3	15.0	18.6	21	18.6	?	2
11	3	20.5	12.3		6	30.0	?	3
12	2½	6.6	10.0		10	13.5	0	8
13	5½				32	10.3	1	11
14	5¼				34	9.3	0	11
Total	36				169	16.3	2	35

Discussion of Brooding and Feeding. The brooding of this female was much less consistent than that of the July bird, partly because of her erratic behavior on the first day resulting in an abnormally small percentage of time spent on the nest (even though I do not start the record until her return at 9:05), partly because of the cool weather that caused her to brood more than usual. She was more erratic than the other bird in the length of periods on and off, almost without exception these being both shorter and longer every day than with female 1. The average lengths of brooding at the August nest during the first three days approximate those of the first two days at the July nest, and the next three days that of the third day at the earlier nest. Her average time off was far longer on the first two days than that of the first female and shorter on the next two. The length in minutes of her periods on and off were as follows:

August 6, A.M. 21 (15) 15 (19) 38 (14, 13) 7 (8) 11 (7, 23); P.M. (5) 6 (15, 16, 13) 7 (7, 21) 49 (8, 25).

August 7, A.M. 15 (12) 20 (20) 25 (21) 40 (20) 37 (13); P.M. 24 (22) 27 (19) 23 (21) 12 (5) 4 (6) 10 (10).

August 8, A.M. (13) 12 (21) 15 (2) 9 (10) 13 (8) 40 (2) 8 (12); P.M. (13) 14 (5) 14 (14) 18 (5) 10 (17) 15 (17, 11).

August 9, A.M. 27 (13) 14 (5) 14 (14) 18 (5) 10 (17) 15 (17, 11).

August 10, P.M. (27) 7 (14, 7) 36 (9) 16 (16, 8) 23 (12).

The variation in the length of periods on was noticeable: 7 to 49 minutes, August 6; 4 to 37 minutes, August 7; 8 to 41, August 8; 10 to 18, August 9; 4 to 33, August 10; and 8 to 19, August 11. The same was true of her periods off: 5 to 25,

August 6; 5 to 22, August 7; 2 to 27, August 8; 5 to 13, August 9.

As to feeding, although this bird was as deliberate as the other during the early part of nest life, she showed typical behavior by speeding up from the sixth day on. She did not often bring large objects and almost never carried more than one at a time.

In ninety cases the number of seconds spent at the nest in feeding was measured; in this respect her behavior did not differ much from that of the other bird during the first six days, except that the periods fell into four-day and two-day groups rather than two three-day periods, but during her last three days she worked much more rapidly. (This bird never fed more than one nestling at a time, while the other often did so.) The periods on August 6th to 9th ranged from 21 to 135 seconds, median 47.5; on August 10th and 11th, 12th to 66, median 31 seconds; August 12th to 14th, 2 to 55, median 12. On the 12th and 13th they ranged from 8 to 45 seconds with a median of 13, on the 14th from 2 to 55 with a median of 10.

This female fed regularly from the east rim of her nest and usually faced west when brooding; occasionally she fed from the west or south. During the first six days she left most often to the southwest, and fairly often to the west, south, and northwest, and only rarely in other directions. But during the last three days she left predominantly to the east and south, and seldom in any other direction. During the first six days she left by climbing up the branches three times; during the last three she did this twenty-one times. This marked change in methods of departure was entirely different from female 1, who continued her old habits throughout the nesting period.

THE BEHAVIOR OF THE FEMALES

It was a fortunate chance that enabled us to study the behavior of two females of the same species that had the whole care of their families.

Did they succeed in raising all the young that were hatched? It is probable that the first did so, but problematical as to the second. This species usually lays four eggs, but Harlow ('18) states that "sometimes 3" constitute a full set. Judging from the evident inexperience of the male in the first case and the female in the second, it is improbable that either pair had already raised a brood; the lateness of the dates would indicate that each female had laid two sets previously. If this were so, it would not be surprising that three eggs should comprise the full clutch. The second female may have lost one of three pos-

sible offspring, either through the failure of one egg to hatch, or the death of a nestling when very young. The inaccessibility of the nest was unfortunate from our point of view, but may have saved the brood from the neighboring red squirrel.

In her failure to increase to any great extent her rate of feeding until two young had left the nest, the first female behaved more atypically than the second. But in other respects the latter was much more erratic and original in her ways than the former—in the abnormally small amount of brooding on August 6th, in the greater variability of periods on and off, and in the striking changes in conduct during the last three days both in the matter of chipping and in methods of leaving the nest. Yet on the whole the females were more alike in their behavior than different when we compare them with other Warblers, as may be seen in Table III, where the results are summarized of all published studies on birds of this family that give sufficient data to be representative.

It will be seen that Oven-birds (*Sciurus aurocapillus*) follow a much slower rhythm than the arboreal Warblers of the table; hence they will be disregarded. In the matter of brooding, the 11 females fall into four groups: short periods of 6.2 and 6.6 minutes, the Yellow Warblers (*Dendroica æstiva æstiva*) and one of the Black-throated Blues (*Dendroica cærulescens cærulescens*); medium periods of 9 to 11 minutes, the other Black-throated Blue, the Myrtle Warbler (*Dendroica coronata*), Redstart (*Setophaga ruticilla*), and both Magnolia Warblers (*Dendroica magnolia*); long periods of 14 and 15 minutes, Chestnut-sided Warbler (*Dendroica pensylvanica*) and the first Black-throated Green; and, finally, very long periods of 18 to 20 minutes, the second Black-throated Green and the Northern Parula (*Compsothlypis americana pusilla*). The last named Warbler is the only one of the eleven having a longer average period of brooding than our two birds. It is probable that long periods are not necessarily inherent in this species any more than in the others, but are merely a reflection of the lack of interruption.

In the columns dealing with the rate of feeding, the first Black-throated Blue and the Parula Warbler are not comparable with the others, because they were observed only during the first half of nest life, when feeding is typically slower than during the last half; the other studies cover to a greater or less extent the whole period. If we compare the rate of feeding at our two nests with those of the nine arboreal Warblers where both parents were active, we see that it was very much slower. However, the table gives no indication of the size of the meals brought nor of the number of young fed at each trip. Also it

TABLE III

COMPARISON OF BROODING AND FEEDING AT SIXTEEN WARBLER NESTS.

SPECIES	*Average length of brooding*	*Rate of feeding both female birds*		*No. of times female fed*	*male fed*	*No. of young*	*Age of young observed*	*Hours*	REFERENCE
Yellow Warbler I		4.5	5.5	1560	813	3	0-10	144	Bigglestone, '13
Yellow Warbler II	6.2	3.7	6.3	277	112	5	0- 9	29	Mousley, '26
Black-throated Blue I	6.6	(15.0)	(20.2)	46	16	2	0- 5	15½	Mousley, '24
Black-throated Blue II	9.1	5.6	11.3	193	201	4	2-10	36½	Nice, '30b
Maryland Yellow-throat		4.7	10.7	552	682	3	0- 8	98	Shaver, '18
Myrtle Warbler	9.0	10.9	24.4	48	60	3	3- 9	19½	Nice, '30a
Redstart	9.5	13.6	18.8	32	12	4	1- 9	10	Mousley, '24
Magnolia I	10.5	9.8	15.5	58	34	3	1 9	15	Mousley, '24
Magnolia II	11.0	10.9	17.5	91	118	3	0- 8	26½	Nice, '26
Chestnut-sided	14.2	11.5	28.1	40	58	3	1- 9	18¾	Mousley, '24
Black-throated Green I	15.1	19.4	19.7	220	6	3	0- 9	73	Nice,
Black-throated Green II	18.3		16.3	169	0	2	0- 9	36	Nice,
Parula Warbler	19.9	(13.6)	(42.9)	21	45	3	0- 5	15	Mousley, '24
Oven-bird I	65.0	38.4	76.0	38	37	2	0- 8	48	Mousley, '26
Oven-bird II	25.7	28.0	48.9	38	28	2	1- 8	31	Nice, '31
Oven-bird III	27.1		35.5	54	0	3	0- 3	32	Nice, '31

must be remembered that there were fewer young in the second Black-throated Green nest than in any other, while three of the nests contained more young than did the first of our 1931 nests.

The feeding rate of the females alone is of especial interest. Both Yellow Warblers fed at very rapid rates, once every 6.3 and 5.5 minutes, but one had five young and the other had to assume the whole task of feeding after the sixth day, when her mate was greatly frightened by a snake that carried off one of the young. The Maryland Yellow-throat (*Geothlypis trichas*) comes next with a feeding every 10.7 minutes; she and her mate raised a Cowbird besides two of their own young, truly a remarkable feat for such small birds. The Black-throated Blue female fed her four young on an average of once every 11.3 minutes. Five birds with much the same rate come next, a Magnolia Warbler (15.5), the second Black-throated Green (16.3), the other Magnolia (17.5), the Redstart (18.8), and the first Black-throated Green (19.7). The Myrtle Warbler and Chestnut-sided lag considerably behind with rates of 24.4 and 28.1 respectively.

The second Black-throated Green female proves to have the median rate of all the eleven Warblers, with the first one not much different. Here apparently lies the explanation for the slow rate at which their young were fed; the females appear to have followed their inherent rhythm, not bestirring themselves to feed any faster to make up for their delinquent mates.

Whether this inability to change caused the death of one little bird in the August nest it is impossible to say. The first female, we believe, adjusted herself successfully to the situation by the large size of the meals brought, even though she persisted abnormally long in a slow rate of delivery.

It is interesting to note in the table that in two of the sixteen pairs, the parents fed almost equally, in five the male outdid the female, but in nine she assumed the larger share.

BEHAVIOR OF THE MALES

We believe that our experiences this summer were atypical, and that as a rule the male of this species feeds his young.

On July 1, 1928, I found a nest at Grey Rocks (Pelham) conspicuously situated, twenty-five feet from the ground and nine feet from the trunk of a hemlock. I could not examine the contents, but the young must have been about half grown, for the female did not brood, yet the nestlings were not developed enough to be noisy or visible above the rim of the nest. From 8:30 to 10:30 the female fed 15 times, the male 6—once in 5.7

minutes for both, once in 8 minutes for the female. Four of the insects offered by the female were large, one was small; once several were brought at one trip. During the first hour the male gave 287 songs. Unfortunately the following morning the nest was empty.

A nest containing four young about six to eight days old was watched for six and one-half hours on two days by Stanwood ('14); the male fed 22 times, the female 25—once in 8.1 minutes for both birds, once in 15 for the female alone.

At a nest in the Berkshires found June 29th by Reading and Hays ('31) the male fed a third as much as his mate, who "invariably brought a heavier load." When both met at the nest, he sometimes passed the food to her. In a letter Mr. Hays tells me that the young were fed during the earlier part of nest life about 10 to 12 times an hour, and later about 12 to 14 times an hour. Two of the four young perished during storms, one of the survivors leaving July 5th, the other July 7th. The female of this pair fed the young when held in people's hands, and Job ('17) describes a male that was equally bold. In no less than nine cases we have seen male Black-throated Green Warblers feeding young out of the nest at Grey Rocks.

What is the explanation of the dereliction of our two males in 1931? The second male may have been killed, or his nesting ardour may have waned so late in the season. (One of my Song Sparrow males, apparently wearying after five months of nesting duties retired to molt, leaving the September brood to be brought up by his indefatigable mate, who succeeded in raising two offspring.)

As for the first Warbler, he appeared to be unaware of the existence of his offspring until he was attracted to the nesting site by the excitement of his mate over the young that had left the nest. The excessive sound and movement on her part appeared to have set his feeding reaction in motion, for he did not examine the nest before returning with a caterpillar eleven minutes after his first appearance. Interestingly enough, he started at the very beginning of the feeding cycle, bringing small insects, trying to put them far down the throat, always endeavoring to feed in the nest and ignoring the young that had left the home tree.

In those species where the male does not help incubate but does feed the young, the female must in some manner, either consciously or unconsciously, inform her mate that the young have hatched. We can find no mention in the literature of how this takes place. Harding ('31) tells of a "low-pitched vibrant call ss-hss-ss-hss" given by the female Black-throated Blue

Warbler to call her mate to the nest; in a letter the author states that this is sometimes used by the male in the same manner. We believe that our first female's chipping in response to her mate's singing might have been meant as a signal to him, but if so, he failed to understand.

DATES OF YOUNG SEEN AT GREY ROCKS

In 1927 we were at Grey Rocks from June 28th to August 23d, in 1928 from June 23d to August 26th, in 1931 from June 11th to August 30th. In these three seasons we have recorded one brood of these Warblers being fed out of the nest in June (June 28, 1928), six in July, and seven in August—viz. two broods August 7, 1928, two August 14, two August 21, 1931, and one August 23, 1928. From the preponderance of late dates it seems probable that two broods are sometimes raised. The unusually long season of song gives additional evidence.

SINGING OF THE BLACK-THROATED GREEN WARBLER

This Warbler is by far the most charming singer of the Grey Rocks *Compsothlypidae* and also probably the most untiring. His energy is almost unbelievable. The season is long, birds remaining in apparently full song till almost the end of July, and singing to some extent through the first week of August, my latest date being August 9, 1927. In the record of Warbler one, as shown in Table I, there is some decline in singing after July 15th, but the hour on the 21st formed an exception.

Distance from the Nest. Our first Warbler sang from 35 to 45 yards from his nest, the second 75 yards away. These distances are far greater for this species than those given by Mousley ('19) for Hatley, Quebec—namely, 12, 14, and 20 yards. Perhaps it is characteristic of Warblers at Grey Rocks to sing at longer distances from the nest than the Quebec birds. Mousley gives 7 and 18 yards for the Magnolia Warbler, while the bird I studied ('24) sang from 20 to 100 yards from his nest. He gives 10 to 18 yards for a Blackburnian Warbler; the one watched in Pelham this past summer ('32) habitually sang 150 yards from his nest. Both in this case and in that of our second Black-throated Green Warbler the deciding factor seemed to be the position of suitable groves; when the males had to choose between singing near their nests in small trees in one case and in hard woods in the other, and singing far away in thick growth of conifers, they both preferred the latter.

Varieties of Song. This species has two main songs—the sweet *trees, trees murm'ring trees,* which I call A and the less

distinctive *See see see see wee see*, which I call B. Thayer ('07) states that the latter is "at least as often uttered and in midsummer is the commoner of the two" around Monadnock Mountain, New Hampshire, but at Grey Rocks it is not heard more than a fourth as often as A. Warbler one was peculiar in his very small indulgence in B. I have not noted any special variations in this song.

As a rule A is not varied markedly by our Grey Rocks birds, but in 1931 two males with adjoining territories gave a peculiar form which consisted in the insertion of four rapidly uttered quavering notes before the final *trees: trees, trees, murm'ring twiddle-diddle trees*. One of these birds was heard to give a normal B.

A peculiarity of this species is the utterance of chips in between songs when singing A. I have never heard it with B. This chipping may be double or single, and varies in amount from two or three notes before each song to a practically continuous utterance interrupted at brief intervals by the songs. Curiously enough, the chipping often seems to come from a somewhat different part of the tree from the songs, perhaps ten feet or more away—something I have noted also with Magnolia and Blackburnian Warblers. Different minutes contained the following numbers of chips and songs: 5 songs and 11, 14, and 30 chips; 7 songs and 37 chips; 6 songs and 52 chips; 8 songs and 58 chips; 7 songs and 73 chips. Warbler one introduced chipping into about a third of all his singing, in about one half of the morning singing and about one tenth of the afternoon singing. Perhaps chipping is an expression of excess of energy. From our standpoint it distinctly mars the æsthetic effect of the pretty song.

This Warbler gave three forms of A—the complete song—A-1—lasting 1.1 seconds, and two incomplete versions, one without the first note, A-2, the other without the last, A-3. This third version was not heard except July 16th, 19th, and 20th and amounted to only one per cent of the total number of songs. (I heard it given from two other males July 25th.) A-2, which made up about 29 per cent of all the songs, was characteristically associated with the chipping, only rarely being given by itself, this happening typically just before the beginning of a session of chipping; *i.e.*, he sometimes swung into the shortened form before he started the chips, or he might be chipping with A-1 and then change to the abbreviated form. About 32 per cent of the morning songs belonged to A-2, but only 4 per cent of those given in the afternoon. Chipping occurred with about one fourth of A-1 and six sevenths of A-2.

One reason for the large total of singing reached by this species is the rapid rate at which A is given, from 6 to 9 and occasionally 10 times a minute. The average rate of 1180 minutes of Warbler one in the morning was 7.4 songs a minute; the average rate of 528 minutes in the afternoon was 6.2 songs. As to intervals between the beginnings of songs, 95 measured by stop watch in the mornings varied between 5.1 and 13 seconds, the median being 7. Thirty-one afternoon intervals varied between 6 and 12.5 seconds, the median being 8.

Curiously enough, B was not heard from this bird until July 12th, when 13 of this form were given; the numbers on the following days varied from 0 to 81 until July 20th, when 310 were uttered, a third of the total amount of singing heard that day. We thought it might be characteristic of the very early morning, but this did not prove to be the case, since it was never heard earlier than 5:30 A.M. nor later than 6:16 P.M. Five hundred and eight of the 14,005 songs were B, or 3.6 per cent of all the singing. B is delivered at a more leisurely pace than A. Thirty minutes of this Warbler's singing varied between 3 and 8 songs a minute, both the median and average being 5. Thirty morning intervals recorded with another bird July 16, 1928, varied between 9.5 and 16.5 seconds, the median being 11.2.

Total Amount Sung. The largest number of songs recorded in any one hour was 466 on July 15th from 8:02 to 9:02 A.M. The longest period of uninterrupted singing was 74 minutes from 7:47 to 9:01 on this same day.

Of the 55 morning hours, singing was recorded in all but one; of the 33 afternoon hours, in all but five. The average amount of singing per hour (except for the six silent ones) varied in the mornings from 103 to 317, averaging 194; in the afternoons from 11 to 172, averaging 84.

As to the per cent of time spent in singing, it varied in the mornings from 26.6 (July 16th) to 79.4 (July 14th), and in the afternoons from 8.8 (July 19th) to 45.5 (July 15th). It is unfortunate that the Warbler sometimes sang too far away to be heard, so that these lowest figures are probably not representative.

All the figures point to greater energy in the morning—the rate, the intervals, amount of chipping, the proportion of hours when there was no singing, the average number of songs per hour, and the per cent of time devoted to singing.

SUMMARY

1. The young in the first nest were raised with no assistance from the male until the last two days, when he brought 11

meals in contrast to his mate's total of more than 245. The young in the second nest were raised entirely by the female.

2. The first female incubated for periods ranging from 34 to 50 minutes, absenting herself for periods ranging from 9 to 26 minutes. The second female once incubated for 99 minutes at a stretch; her absences varied from 13 to 20 minutes.
3. Both females brooded for longer periods than the majority of arboreal Warblers that have been studied, averaging 15.1 and 18.3 minutes respectively.
4. Both females fed at slow rates, the average for the first being once in 19.7 minutes, for the second once in 16.3 minutes.
5. The first female adapted herself successfully in the absence of her mate by often bringing large insects and several at a time; the second female increased her feeding rate markedly during the last three days.
6. Both females made definite efforts to get their last young out of the nest and to lead them to a distance.
7. The young in the first nest left at the age of 8 and 9 days; in the second, at the age of 8 days.
8. The male of the first pair did not seem to know of the existence of his young until two had left the nest.
9. The male of this species possesses extraordinary energy for singing. The first Warbler gave 466 songs in a single hour and more than 14,000 in the 94 hours of observation.

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GENERAL NOTES

Strange Disappearance of Nesting Penikese Island Terns.—For seven years Penikese Island, lying southeast of New Bedford, Massachusetts, in Buzzard's Bay, has been visited by members of the Northeastern Bird-Banding Association who band thousands of Common Terns (*Sterna hirundo*) and Roseate Terns (*Sterna dougalli dougalli*) there annually each breeding season. This year (1932) for the first time a limited amount of trapping was done, and fifty-eight adult Common Terns were captured by using a simple wire pull-string trap set over the nests. One Common Tern was taken wearing band 404788, which was placed on the bird when a chick on Tern Island, Chatham, Massachusetts, fifty-two miles northeast of the place of capture, the date of banding being July 18, 1926.

This fascinating rookery has an interesting historical background and is different topographically from the flat sandy islands or low sand-bars on which terns nest in the other colonies in the Cape Cod region. Penikese Island was the home of the Anderson School of Natural History founded by Louis Agassiz. In later years and until 1920 it was used by the Commonwealth of Massachusetts for a leper colony where unfortunates afflicted with this disease were concentrated and tended. The graveyard, ruins of the hospital, laundry, cottages, and other buildings, which were burned or dynamited upon the discontinuance of the island for this purpose, are grim reminders of the past. In 1924 the island was transferred to the Massachusetts Division of Fisheries and Game by legislative enactment and declared a Wild Life Sanctuary. The warden, H. S. Turner, and his family of three are the sole inhabitants and live there throughout the year. The area of the island is from eighty-four to one hundred acres and is made up of rolling uplands covered largely with grass, but devoid of trees except a struggling group of Scotch pines planted in a sheltered hollow. The shore-line is so covered with stones that there is hardly room for even a few terns' nests in the sand between. There are three small ponds, one of which contains a satisfactory flow of fresh water where the birds drink and bathe. Here, too, ducks and geese remain throughout the winter.

The wild-life inhabitants, in addition to the terns, are hundreds of Eastern Garter Snakes (*Thamnophis sirtalis sirtalis*) and numbers of common Cotton-tail Rabbits. The snakes, we are informed, were introduced upon the island by Professor Agassiz for biological experiments, and as there are no natural enemies to hold their numbers in check except man and an occasional hawk, they have multiplied until they are very numerous. Some conception of their numbers may be gained from the following record of those killed by Warden Turner, who spent a small portion of each day listed below in extermination work:

April 15, 1932— 65 snakes destroyed
April 18, 1932—165 snakes destroyed
April 20, 1932—175 snakes destroyed
April 21, 1932— 40 snakes destroyed
April 22, 1932— 45 snakes destroyed
April 23, 1932— 60 snakes destroyed

Eggs and young terns are eaten by these reptiles, and the destruction caused by them must be considerable, although apparently up to the present year there was no appreciable diminution in the numbers of young raised to maturity. Snakes have been observed swallowing eggs, and we

captured one with a partly grown chick in its stomach. The terns are present in thousands, and to count their numbers with any degree of accuracy is an impossibility, but we estimate that between ten and fifteen thousand make this island their breeding ground.

Cotton-tail rabbits were released on the island by the Division of Fisheries and Game, and they have multiplied greatly as they have no enemies but a passing hawk or Snowy Owl. In Warden Turner's opinion they are not molested by the snakes. Each fall many are trapped and shipped to parts of the State where the covers are depleted of this popular little game animal.

The terns have undoubtedly inhabited the island for many years, and their nests are everywhere in the long grass. One can stand on an elevated point overlooking the rolling uplands and observe adult birds in every direction, in the air or on the ground covering eggs or young. The location of these nests in the long grass is quite in contrast to the breeding areas selected by the terns in the other large rookeries on Tern Island, Chatham, Egg Island, Hyannis, and Muskeget Island, where nearly open sand is chosen in preference to grassy sections. Here and there are brown patches formed by dead grass which is killed by the terns and closely matted to the earth. A slight depression in this soft material makes an ideal nest. To the bird-banders there is no more delightful picture than the beautifully colored nesting birds against the background of green in as naturally secure a locality as can be found in the State.

On July 2d, 3d, and 4th, 1932, there were eggs in great numbers and few had hatched. During those three days only 490 young could be found and these were banded, but the possibility at this time of banding several thousand later in the season seemed excellent.

Ten days after the writer visited this colony four other members of the Northeastern Bird-Banding Association, who have worked there in other years, arrived to continue the banding and were astonished to find that of the thousands of adult terns not over five hundred were present, an unprecedentedly small number at the height of the breeding season. There were very few eggs, and these were scattered about, some broken and many more out of the nests. Only four live chicks were found and almost no dead ones: of the 490 banded by the writer and his party, only one was noted, and that was dead.

Two question at once arise: why did the birds desert eggs and young, and to what place did they go? Warden Turner noticed no diminution in numbers for ten days after our departure. When the adults disappeared, many of the eggs and young would, of course, be easy prey for the snakes. The only explanation that the writer can offer for the departure of the adults is the disappearance of their food-supply, for if the schools of small fish upon which the terns prey leave the immediate vicinity of the island, the old birds would be forced to leave and thus to desert eggs and young. Reports are current along the Massachusetts coast that the eel-grass which is generally abundant in every favorable spot has entirely vanished. Can there be any connection between the disappearance of the eel-grass and the small fish, thereby explaining the desertion of Penikese Island by the terns?—CHARLES B. FLOYD.

Early Bird-Banding in Europe.—After reading in the April, 1932, issue of *Bird-Banding* the interesting account of "An Early Successful Bird-Banding Venture in England," I wondered whether any notice had

been taken in modern literature of an even earlier record than that mentioned in Mr. Fogg's article. There is in my possession a copy of "*British Zoölogy.* / Vol. II. / Class II. Division II. / Water-Fowl. / with an / appendix. / Warrington / Printed by William Eyres, / for / Benjamin White, at Horace's Head, Fleet Street, London. / MDCCLXXVI." This is part of Pennant's British Zoölogy. On page 356 in speaking of the Common Heron, the author says: "It is said to be very long lived; by Mr. Keysler's account, it may exceed sixty years[1]; and by a recent instance of one that was taken in Holland by a hawk belonging to the Stadtholder, its longevity is again confirmed, the bird having a silver plate fastened to one leg, with an inscription, importing it had been before struck by the elector of Cologne's hawks in 1735."

Not being able to find a copy of Keysler's Travels in the Milwaukee Library in order to investigate this citation, I asked Mr. Charles L. Whittle to consult the work, which he could probably find in some library in New England. This he succeeded in doing, and the following reference from the work in question gives the details of the heron-banding cited by Pennant, as sent me by Mr. Whittle: 'In this palace[2] the court often diverts itself with hunting the heron, and every year, at the conclusion of it, a heron, whose good fortune it has been to be taken alive, is, for memorial, set at liberty with a silver ring on its foot, on which the name of the reigning elector is engraven. No longer ago than last spring, one of these birds was taken a second time, having on its ring the name of duke Ferdinand, grandfather to the present elector, so that it has survived its former adventure above sixty years; they put a ring with the present elector's name upon its leg, and gave it its liberty again.' From Vol. I, p. 87, "Travels through Germany, Bohemia, Hungary, Switzerland, Italy and Lorrain by John George Keysler. Translated from the Second Edition of the German, and published in London in 1760 by G. Keith in Gracechurch Street, as the third edition."

Calculating from the date of the earlier of these two references, one can be definitly assured that the banding of herons was a well established procedure at least as early as 1669. There is no doubt that it was done much earlier than this. The common heron is *Ardea cinerea cinerea.*—C. S. Jung, 2502 East Stratford Court, Milwaukee, Wisconsin.

Nine More Snow Bunting Returns-W.—In *Bird-Banding*, Vol. I, October, 1930, pages 187 and 188, I gave my list of returns of Snow Buntings (*Plectrophenax nivalis nivalis*) for the winter of 1929-30, and in Vol. II, July, 1931, page 127, I published all my returns and recoveries of this species as of that date. Since that time two more recoveries were reported by me in *Bird-Banding*, Vol. III, April, 1932, pages 68 and 69. During the winter of 1931-32, I had nine more returns of this species at my station. These are tabulated below, together with three returns-2 previously reported as returns-1.

[1]Keysler's Travels, vol. I, p. 70.

[2]The palace above referred to is that of Starenberg, three leagues from Munich, belonging to the Elector of Bavaria. The above account was published as "Letter IX," dated Munich, June 21, 1729. Keysler was a Fellow of the Royal Society in London.

Band-Number	*Date Banded*	*Returning Dates*	
B80250	February 9, 1929	January 31, 1931	
B80250	February 9, 1929	January 24, 1932	(Return-2)
C14873	December 22, 1929	January 18, 1931	
C14873	December 22, 1929	January 8, 1932	(Return-2)
C14891	February 14, 1930	January 8, 1931	
C14891	February 14, 1930	January 12, 1932	(Return-2)
C98288	January 13, 1931	March 16, 1932	
C98298	January 20, 1931	March 17, 1932	
C98300	January 20, 1931	March 20, 1932	
C98309	January 24, 1931	March 14, 1932	
C98315	January 31, 1931	March 17, 1932	
C98317	February 2, 1931	March 13, 1932	

In the above list it will be noted that there was only one bird, B80250, that I banded during the winter of 1928-29, and two, C14873 and C14891, of those banded by me during the winter of 1929-30; also, that B80250 was not retaken during the winter of 1929-30. Although the winter of 1931-32 was considered an open one, the number of Snow Buntings banded by me was as large as during any previous winter. The following table shows the number of Snow Buntings banded by months during the seasons of 1928-29 to 1931-32. In addition, I have had twenty-three returns.

	Dec.	Jan.	Feb.	Mar.	Apr.	May	No. of Birds Banded
Winter of 1928-29		26	38	16		1	81
Winter of 1929-30	4	9	13				26
Winter of 1930-31		35	10	12			57
Winter of 1931-32		1	14	61	5		81
Totals	4	71	75	89	5	1	245

Oscar McKinley Bryens, R. F. D. No. 1, McMillan, Luce County, Michigan.

Some Rare or Unusual Birds Banded on Cape Cod.—One hundred and forty-four species of birds have been banded at the Austin Ornithological Research Station from the time of its establishment in June, 1930, to date. Of this number, the following birds are of particular interest, largely because of their rare or accidental occurrence in New England. Some of these birds were included in the lists of Station bandings, published in the January, 1932, number of *Bird-Banding*, but specific data were lacking.

On September 20, 1930, an adult Acadian Flycatcher was captured, identified, and banded by Dr. O. L. Austin, Jr. An immature Yellow-bellied Flycatcher and an adult Philadelphia Vireo were banded on September 19, 1931.

In the late afternoon of April 12, 1932, an adult male Summer Tanager was seen rather close to headquarters, on the edge of our thicket-bordered pond. On the 15th it was trapped and banded, and on this date we saw it joined by a female. The male repeated in grain-baited traps from the 17th to the 20th, but the female was never taken, although the pair were usually seen together. The birds were not seen after the 20th. During a part of this period the weather had been cold and unseasonable, with consequent diminution of insect life, so that hunger must have led the male to depart from its usual dietary habits.

Coincident with the visitation of the Tanagers, was the appearance on April 16th of a full-plumaged adult Worm-eating Warbler. This bird

was trapped eight times during the next two weeks, and it was seen once or twice almost daily until May 15th, when it was last noted. There are on record numerous occurrences of this warbler in Massachusetts, but so far as we know, this is the only definite record for Cape Cod. About the time of capture of this species and the Summer Tanager, many other unusual birds were reported in New England, all of them carried here by a severe storm that swept northward, coastwise, from the southern Appalachian region on April 11th and 12th.

An adult male Cerulean Warbler was banded on May 17, 1931. According to Forbush's "Birds of Massachusetts and Other New England States," Vol. III, 1929, p. 247, this constitutes the seventh record for the State.

The regular occurrence of the Western Palm Warbler in New England each fall is a matter of common knowledge. Spring records are so scarce, however, that the banding of a bird of this subspecies on April 22, 1932, is worth citing. It is possible that the bird wintered in the region.

On August 12, 1932, an adult Lark Sparrow was banded at the Station. —MAURICE BROUN, A. O. R. S., North Eastham, Massachusetts.

A Wood Thrush Recovery.—On June 17, 1926, I banded three fledgling Wood Thrushes just before they left the nest. On May 7, 1932, Mrs. Marie V. Beals, of Elmhurst, Long Island, New York, captured one of these Thrushes, 255899. Elmhurst is about twenty-seven miles west of the place where the bird was banded. This bird was almost six years old on the date of recapture. Mrs. Beals writes that the bird was in excellent condition. As the bird was banded about a mile from my trapping station, I cannot say with any certainty that it has never returned to Huntington. As the bird has not repeated at Mrs. Beals's station up to June 13th, and considering the early date of recapture, it may possibly be a migrant at her station. Owing to the shape of Long Island, it is quite probable that spring and fall migrations are eastward and westward movements.—GEOFFREY GILL, Huntington, Long Island, New York.

Two Pairs of Tree Swallows Mated During Two Seasons.—In *Bird-Banding*, Vol. III, pages 22 and 23, Mrs. Kenneth B. Wetherbee gives us interesting data on "Two Pairs of Tree Swallows Mated During Two Successive Seasons." In the summer of 1928 I began trapping adult Tree Swallows at the time they were feeding their young in order to see if the same pair would use the same house more than one season. The history of mated pair B5203 ♀ and B5204 ♂ follows. They were both banded on June 24, 1928, and their young on July 1, 1928, were given bands B5212, B5213, B5214, and B5215 before they left the nest. On June 28, 1929, B5203, and B5204 were retaken in the same house used in 1928, and their six young were given bands B99361, B99362, B99363, B99364, B99365, and B99366. On July 1st they all left the nest excepting B99361, which had died. In 1930 I did not trap B5203, but B5204 was taken on June 22, 1930, with C67899 ♀, and they were occupying a different house.

A second pair of Tree Swallows has a rather interesting history also, so far as trapping them is concerned. This pair was also banded at the time they were feeding their young. They were banded on June 24, 1928, B5201 ♀, and B5202 ♂. B5201 has not been retaken by me, but B5202 was retaken on June 19, 1929, in a house about one hundred feet northwest

of the house used by B5202 and B5201, with B99354 ♀, which was banded on June 23, 1929. In the summer of 1930 these birds (B5202 and B99354) were not retaken, but in the summer of 1931 I trapped B5202 on June 22d, and B99354 was recaptured on June 20th—a mated pair. It may well be that these birds, B5202 ♂ and B99354 ♀, were mated in 1930 also, as they were in 1929 and 1931. B5202 is at least four years old.—Oscar McKinley Bryens, R. F. D. No. 1, McMillan, Luce County, Michigan.

The Occurrence of Botulism in a Herring Gull.—The observations and researches of competent bacteriologists during the last three years warrant the conclusion that botulism, popularly known as ptomaine poisoning, takes heavy toll from wild bird life. The specific bacilli which alone cause the disease, as well as the toxins produced by these organisms, infect the soil and are ingested with the food taken by birds. The disease was observed first in ducks. A report of an outbreak of the malady occurring in Turnstones and Sanderlings in 1930 on Cape Cod, Massachusetts, was published in *The Auk*. The following incident is narrated for the sake of listing all species found to have been victims of the disease.

On July 1st an adult Herring Gull was found on the ocean beach near the Austin Ornithological Research Station on Cape Cod, Massachusetts, unable to move. No other gulls were seen in the vicinity, but the shore was littered with dead fish. The bird exhibited an almost complete paralysis as well as other symptoms of botulism. Aided by suitable treatment the gull made a slow, typically progressive, and complete recovery, flying away July 11th. This diagnosis was not confirmed by bacteriological findings but by symptoms pathognomonic of this disease alone.—Oliver L. Austin, M. D., Tuskahoe, New York.

Some White-throated Sparrow and Field Sparrow Returns.—At my banding station in Fairhope, Alabama, I have had the following White-throated and Field Sparrow returns of interest, returns-1 and returns-2.

White-throated Sparrows

Band No.	*Banding Date*	*Returns-1*	*Returns-2*
167904	Jan. 1, 1930	Mar. 30, 1931	Jan. 11, 1932
167906	Jan. 4, 1930	Dec. 6, 1930	Nov. 27, 1931

Field Sparrows

C47659	Feb. 3, 1930	Dec. 24, 1930	Feb. 5, 1932
C47676	Feb. 10, 1930	Dec. 24, 1930	Feb. 25, 1932
C47654	Mar. 1, 1930	Nov. 28, 1930	Jan. 13, 1932
C47655	Mar. 1, 1930	Jan. 5, 1931	Jan. 29, 1932
C47663	Mar. 3, 1930	Jan. 6, 1931	Feb. 5, 1932
C47671	Mar. 8, 1930	Dec. 12, 1930	Feb. 7, 1932
C47673	Mar. 9, 1930	Feb. 13, 1931	Feb. 4, 1932

—Helen M. Edwards, Fairhope, Alabama.

A Cowbird Attempts to Parasitize Barn Swallows.—In 1931 several pairs of Barn Swallows nested successfully under the eaves of the porch of the Austin Ornithological Research Station at North Eastham,

Cape Cod, Massachusetts. This spring one of these banded birds with an unbanded mate again nested in the same place. On June 6th, a female Cowbird attempted to lay an egg in this nest. Both of the Swallows attacked the Cowbird. After several minutes of fighting, the Cowbird and the banded Swallow fell to the steps beneath the eaves, both much exhausted; the other swallow flew away. After a short rest the banded swallow again attacked the Cowbird, finally driving it away. Friedmann lists only one authenticated and one questionable record of the parasitizing of Barn Swallows by Cowbirds. This comparative immunity may be due to the Swallows' habit of attending their nests closely.—OLIVER L. AUSTIN, M. D., Tuckahoe, New York.

Queer Albinism in a Purple Grackle.—On August 17, 1932, my father trapped a female Purple Grackle which had a white spot on the proximal ends of the first six primaries and on each tail feather at one third the distance from their distal ends. The bird had brown irides and was banded A361323. This is the first case of albinism we have found among our seventy-three banded Purple Grackles.—MERRILL WOOD, Harrisburg, Pa.

Juvenile Eastern Song Sparrow Returns to Birthplace.—In the April, 1932, *Bird-Banding*, pages 106-108, I have recorded the return of four juvenile Song Sparrows out of eighteen birds-of-the-year banded the previous season. On account of the fact that the belief is prevalent that young birds do not return, it seems advisable to place on record a more complete record than appeared in the above article.

To the four juvenile returns recorded, I am now able to add another one, B69379, banded July 20, 1931, taken July 11, 1932. This makes five returns out of eighteen juvenile birds born close to my station in 1931, or 27.77 per cent, a rather surprising number of inexperienced birds to survive their first year, which of course included two migrations. That B69379 should be taken at my station for the first time at so late a date as July 11th may be explained by the fact that it probably nested too far from the traps to visit them during incubation and the feeding of the young. The fact that between broods even my near-by nesting Song Sparrows remain away during the period that the young are fed on animal food, probably accounts for the late coming of B69379 for canary-seed. It should be stated that the bird came only once during this period, again behaving much like my near-by Song Sparrows in this respect.

It is also possible to add other facts of interest regarding three of the juvenile birds which returned in April, 1932. As already published, two of the three, B69411 and B69417, nested in the two territories which included my traps. These two birds, in profound molt when again trapped in late August after the nesting season was over, escaped the small army of cats that nightly attempted to ravage their nesting territories. On August 27th another of the returns of April was retaken, B69413, which nested too far away to visit the station until the nesting period was over. The records therefore gratifyingly show that four of the five returning young birds (80 per cent) survived their first nesting season, perhaps to return again in 1933.—CHARLES L. WHITTLE, Peterborough, N. H.

RECENT LITERATURE

Der Vogelzug, Vol. 3, No. 3, July, 1932. Drost and Desselberger open this number with an article on the migration of two species of *Phœnicurus,* the Redstarts of Europe. They find that so many data have now been collected by means of returns and reports of banded birds that it is possible to make definite statements concerning the migration of these two warblers. The ordinary Redstarts *(P. phœnicurus)* breeding in Germany all migrate in a southwesterly direction and occur in October and November in southern France, Spain, Portugal, and Morocco, while the Black Redstarts *(P. ochrurus)* nesting in Germany split up in their migration, some going to the same places as *P. phœnicurus,* others going southeast to Italy, Macedonia, Greece, and Egypt.

Schüz contributes an account of the activities of the Rossitten station from April, 1930, to March, 1932. These two years were the most productive in the history of the station. Thus, out of a total of 168,648 birds banded, by the station staff and coöperative workers since the beginning of the work in 1903, 79,867 were banded in the last two years. Out of a grand total of 7,234 return records since 1903, 3,564 were recorded in these two years. The years reported on witnessed material growth of the facilities and collections of the station as well.

Drost continues his series of papers on recognition marks for determining the sex and age of migrant birds (the first two papers in this series appeared in *Der Vogelzug,* Vol. 1, No. 4, and Vol. 2, No. 3). In this installment he deals with the Stone Chat *(Oenanthe œnanthe),* the two species of Redstarts *(Phœnicurus phœnicurus* and *P. ochrurus),* the Nightingales *(Luscinia megarhyncha* and *L. luscinia),* the Bluethroats *(Luscinia svecica* and its races), the Redbreast *(Erithacus rubecula),* the Accentor *(Prunella modularis),* the European House Wren *(Troglodytes troglodytes)* and the Dipper *(Cinclus cinclus).*

Quednau and Bahr write on the observations of bird migration on the high sea near the Rossitten sand-spit, particularly with reference to the main flight directions, which they found to be almost due east in March, and east and southeast in April. Schüz continues his summary of return records of birds banded in stations other than Rossitten.

Among the shorter articles are notes on the banding stations of Esthonia, by Härms; of Lithuania, by Domaniewski; of France, by Bourdelle; and of Iceland, by Gudmundsson.—H. F.

The Birds of Minnesota. By Thomas S. Roberts, M.D. University of Minnesota Press, Minneapolis, Minn., 1932. It is extremely difficult, in the limited space allotted to a review of this type, to even attempt to do justice to such a fine piece of work as Dr. Roberts' "Birds of Minnesota." For six decades Dr. Roberts has studied the birds of his adopted State with an interest that has been unfailing, so that he has brought to the preparation of this book a knowledge of his special subject equaled by few ornithological writers. The many friends of Dr. Roberts will rejoice with him upon the completion of this fine piece of work, which calls for our unstinted praise.

The first volume contains "An Historical and Bibliographical Review of Ornithology in Minnesota," a section on the geography and climate of the State, a synopsis of its bird-life, chapters on conservation, bird-songs, and bird-banding, acknowledgments, general comment and explanations, and systematic accounts of all the birds of Minnesota, from loons through woodpeckers, followed by a series of forty-nine plates in full color. The

second volume completes the systematic accounts and contains, in addition to forty-one colored plates, a very valuable collection of "Keys and Descriptions" occupying some 276 pages, a bibliography and a general index. Each volume also includes an unnumbered frontispiece.

In the accounts of each species paragraphs are given to General Range, Minn. Range, Minn. Migration Dates, Minn., Nesting, Nests and Eggs, Food and Field Marks, and in many instances, as noted below, to Banding Returns and Recoveries. Then follows the delightfully written accounts of the habits and haunts of the birds, written with a sympathetic understanding and from a depth of knowledge possessed by few ornithologists.

The ninety-two colored plates are an outstanding feature of the two volumes. Printed by the offset process, which gives them a pleasing softness of effect, they are the work not of one but of six bird artists. The late Louis Agassiz Fuertes is represented by one plate, a flock of Bobwhites in full flight. Allan Brooks contributed the two frontispieces of the Wood Duck and Ruby-throated Hummingbird respectively, and some 34 other plates; the remainder are by Weber, Breckenridge, Sutton and Jacques. In addition to the colored plates there are over six hundred text figures, from photographs by Dr. Roberts and others, and from line drawings by Walter J. Breckenridge.

It seems a little strange not to find detailed descriptions of the various plumages of a species in the systematic account of that species, but we must turn to the second volume, to the section on "Keys and Descriptions," for this information. And, after all, is not that the logical place for it? Certainly the amateur bird student will turn to the wealth of illustrations for aid in identifying a newly observed species, and will then refer to the story of the bird's habits and habitat, while the more serious collector will york out the identification of his specimen by means of the keys and detailed descriptions.

For the first time, I believe, in a book on the birds of a geographical unit like Minnesota, banding records are given an important place, such as they must occupy in all future ornithological works. Not only is there an introductory chapter on bird-banding by Frederick C. Lincoln, and one on bird-banding in Minnesota by Dr. Roberts, but a table of Minnesota returns and recoveries is given in a special section of the systematic account of all species which have supplied such records. For example, under Bronzed Grackle there is a table of some forty-five returns and sixteen out-of-state recoveries, while the Giant Red-wing has tabulated nearly one hundred and twenty returns and ten recoveries, from which interesting data may be collated. This recognition of the value of banding records, from a man of Dr. Roberts' experience and standing, is particularly gratifying to the friends of bird-banding, and should provide a new incentive for them to continue their efforts and to increase their banding activities. The records from Minnesota show that much may be done by a few cooperators; how much more would have been accomplished had the number been larger!—J. B. M.

"Portraits of New England Birds."—Published by the Commonwealth of Massachusetts, Dr. Arthur W. Gilbert, *Commissioner,* Department of Agriculture; Dr. John B. May, *Director,* Division of Ornithology, 1932.

This beautiful quarto volume comprises the ninety-two full color plates, by L. A. Fuertes and Allan Brooks and one in black and white by Dr. John B. May, appearing in the three volumes of "The Birds of Massachusetts and other New England States," by Edward Howe Forbush. The plates illustrate three hundred and forty-four species of birds

with five hundred and sixty-four separate figures. In numerous instances there are several paintings of the same species indicating sex, age and seasonal plumages.

Since the three volumes were published, the fourth edition of the "Check-List of North American Birds," prepared by a committee of the American Ornithologists' Union, has appeared. This edition contains many changes in scientific nomenclature as well as new common names of some New England birds which occur here as races, examples being the "Eastern Song Sparrow," "Northern Pine Warbler," etc. In the present volume such changed common names have replaced the old names used by Mr. Forbush in his three volumes.

It is unnecessary again to mention the excellence of the portraits comprising this volume. The State of Massachusetts in issuing the portraits separately has now made them available to everyone and at the low price of $1.75 per copy. Every bird-bander should possess a copy. They may be secured from the Secretary of the Commonwealth, Room 118, State House, Boston, Massachusetts.—C. L. W.

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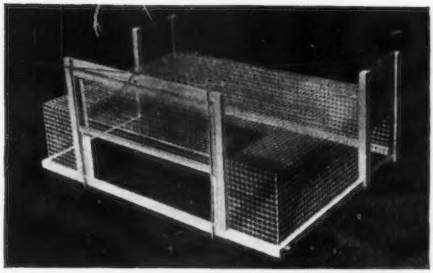

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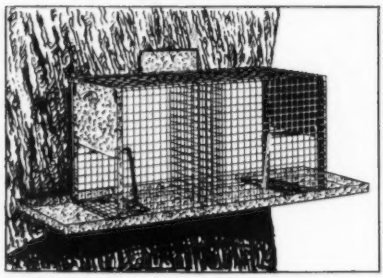

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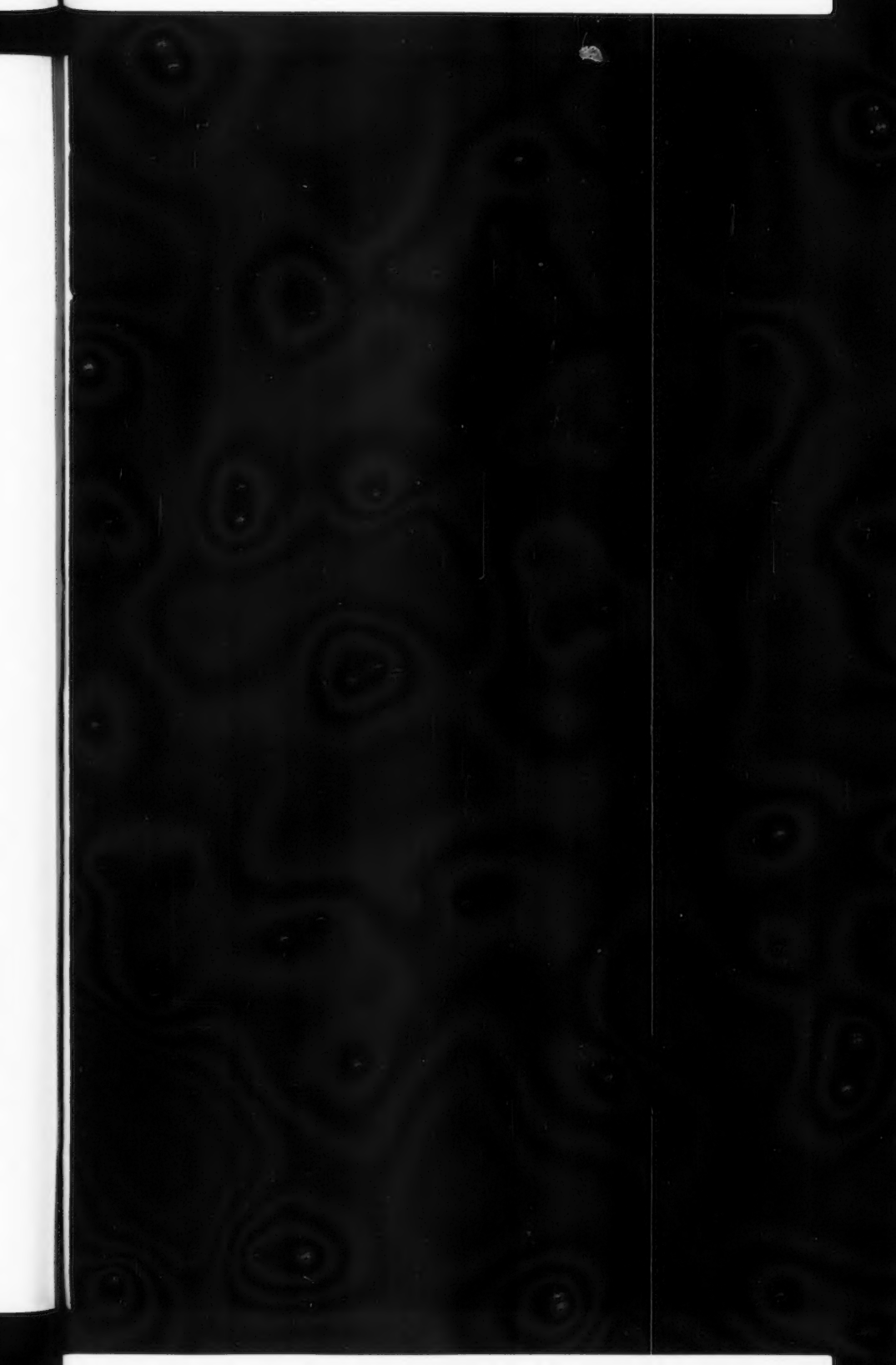

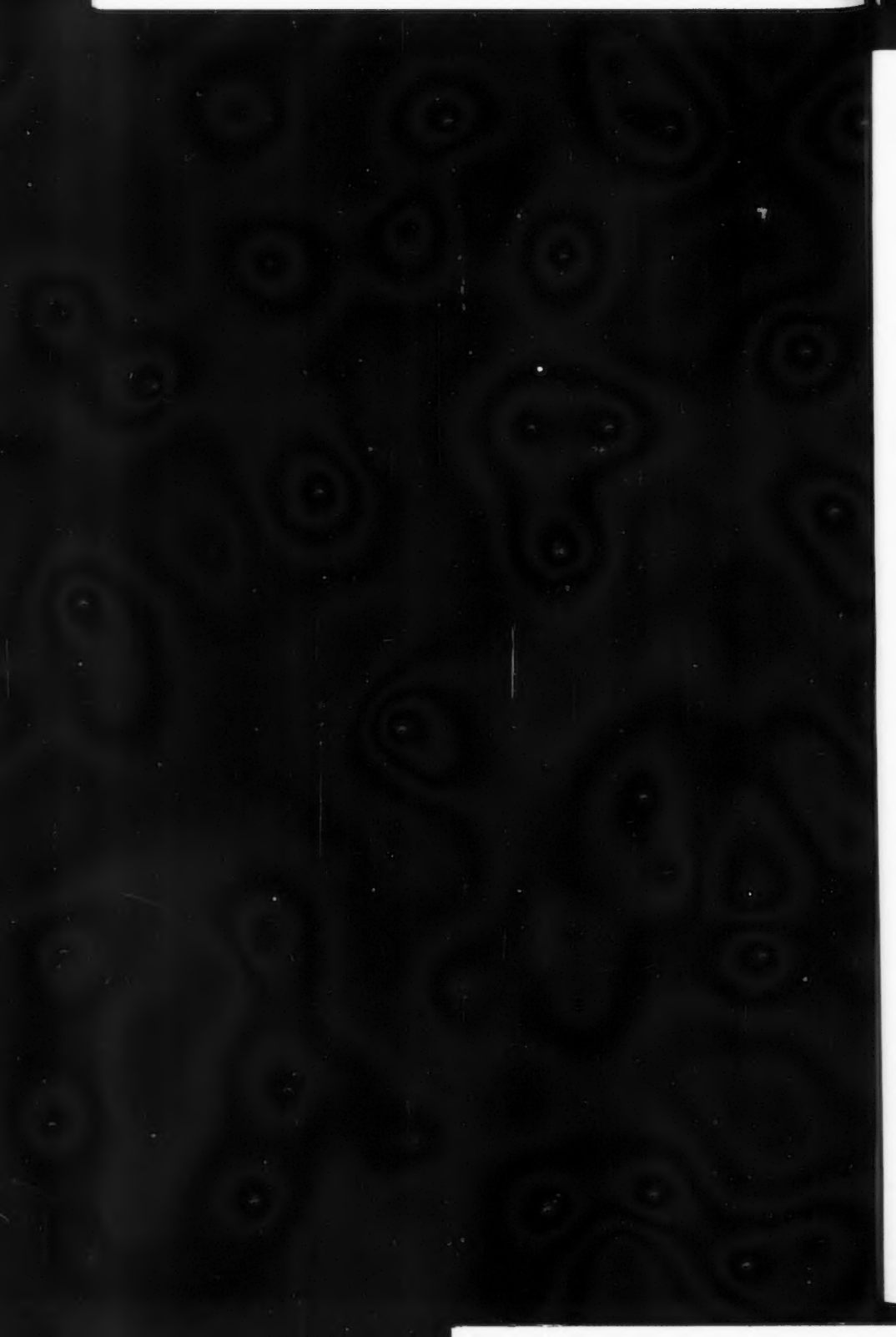

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